AFFDL-TR-79-3083

LEVEL II

AIRCRAFT TRANSPARENCY FAILURE & LOGISTICAL COST ANALYSIS — SUPPLEMENTAL STUDY

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

—> Concern for increasing costs in maintenance of transparency systems has prompted the Air Force Flight Dynamics Laboratory to sponsor this study contract. The object of this study is to identify the high-cost, high maintenance transparency components; identify cause of failures; and recommend corrective programs to reduce cost of ownership to the Air Force Logistics Command.

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20. ABSTRACT (Continued)

The study involved the review of 20 selected aircraft in current inventory to establish an extensive data base relating transparency maintenance activity and associated logistical support costs. An important adjunct to this study was to research design characteristics, perform a failure analysis, and identify associated logistical support cost for each study aircraft.

By using a selective process of correlating the transparency failure modes and maintenance costs with the relative stature of aircraft in current inventory, corrective programs were established and verified by life-cycle cost trades. These corrective programs entailed a comprehensive search for various design improvement that could be innovated to negate the reported failures.

The study results contained herein are an extension of objectives of the original program and are directed at supplementing the corrective programs for six additional aircraft.

FOREWORD

The study presented in this report was performed by the North American Aircraft Division (NAAD) of Rockwell International Corporation (Rockwell) under U.S. Air Force, AFSC, ASD, Wright-Patterson Air Force Base Contract F33615-77-C-3060. This study was performed for the Crew Escape and Subsystems Branch (FER), Vehicle Equipment Division (FE), Air Force Flight Dynamics Laboratory, Air Force Wright Aeronautical Laboratories, Wright-Patterson Air Force Base, Ohio, under Project 2402 "Vehicle Equipment Technology," Task 240203 "Aerospace Vehicle Recovery and Escape Subsystems," Work Unit 24020302 "Aircraft Transparency Failure and Cost Analysis." Mr. C. A. Babish III (AFFDL/FER) was Laboratory Contract Manager.

The basic contract started Jun 77 and was completed Dec 78. On 12 February 1979, a contract extension F33615-77-C-3060, P00004, to identify corrective design improvements for specific aircraft was authorized. This supplementary study includes the further review of the F-4, C-130, A-7D, CH-3. CH-53, and UH-1 aircraft. This report documents the study results for this effort and was released under NA-79-237 by Rockwell International for internal control.

Mr. S. S. Brown was the Program Manager for Rockwell International. Contributing technical personnel were O. F. Neidermann, Engineering Specialties; A. R. Del Mundo, Transparency Design; H. L. Hayes, Transparency Design; R. O. McCarty, Operation and Proposals Estimating; W. R. Marshall of Reliability; and R. M. Hiyama, Mass Properties.

The author wishes to thank the field audit contacts in the Air Force, in the airframe industry, and transparency suppliers for their cooperation and valuable assistance in the collection of maintainability and logistical support data.

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LIST OF ABBREVIATIONS

A/C	Aircraft
ACI	Analytical Condition Inspection
AEDC	Arnold Engineering Development Center
AFB	Air Force Base
AFFDL	Air Force Flight Dynamics Laboratory
AFH	Flight Hours (From AFM 66-1)
AFL	Number of Flights (From AFM 66-1)
AFLC	Air Force Logistics Command
AFM	Air Force Manual
AFM 66-1	Maintenance Management System
AFM 65-110	Standard Aerospace Vehicle and Equipment Inventory, Status, and Utilization Reporting
AFM 127-1	Accident/Incident Data
AFR	Air Force Regulation
AFSC	Air Force Systems Command
AFTO	Air Force Technical Order
ALC	Air Logistics Center
AMS	Avionics Maintenance Squadron
ASTM	American Society for Testing and Materials
AT	Action Taken
ATF/LCA	Aircraft Transparency Failure and Logistics Cost Analysis
BLIS	Base Level Inquiry System
CON-C	Condemnation Costs
CRC	Cost Reduction Curve
DCM	Deputy Commander - Maintenance
DDCC	Delaminations, Deterioration, Cracks, and Chipping
D056	Product Performance System
D062	Spares Requirement System
DS	Distribution and Supply
DSS	Dirty - Contamination, Scored and Scratched
EUMR	Emergency Unsatisfactory Materiel Report
FE	Vehicle Equipment Division
FER	Crew Escape and Subsystems Branch

FH	Flight Hours
FMC	Field Maintenance Cost
FMEA	Failure Modes and Effect Analysis
FMS	Field Maintenance Squadron
FOD	Foreign Object Damage
FSN	Federal Stock Number
HDP	Hydropress Die
HM, How Mal	How Malfunction
HTF	Heat Treat Fixture
I/L	Interlayer
IN	Information Office
INS	Inches
IROS	Increased Reliability of Operational Systems
KFH	Flight Hours (From K051)
KFL	Number of Flights (From K051)
K051	Logistical Support Cost (IROS)
(L)	Left-Hand Side
LAD	Los Angeles Division (Rockwell International)
LB	Pounds
LCC	Life Cycle Cost
LG	Laminated Glass
(L/R)	Left- and Right-Hand Sides
LRU	Line Replaceable Unit
LSC	Logistical Support Cost
LTV	Ling Tempco Vought
MA	Maintenance
MAM	Maintenance Analysis Model Program
MDCS	Maintenance Data Collection System (AFM 66-1)
MDR	Maintenance Demand Rate
MIPS	Material Improvement Projects
MM	Material Management
MMH	Maintenance Man-Hours
MMH/FH	Maintenance Man-Hours per Flight Hour

MMH/MA	Maintenance Man-Hours per Maintenance Action
MTBF	Mean Time Between Failures
MTBMA	Mean Time Between Maintenance Action
MTBR	Mean Time Between Removal
MTBUR	Mean Time Between Unscheduled Removal
MTSL	Master Transparency System List
MU	Wavelength - Millimicrons
NDI	Nondestructive Inspection
NO. (#)	Number
NOC	Not Otherwise Coded
NORM	Not Operationally Ready - Maintenance
NORS	Not Operationally Ready - Supply
NRTS	Not Repairable This Station
NSN	National Stock Number
NTIS	National Technical Information Service
OAFB	Operational Air Force Base
OMS	Organizational Maintenance Squadron
PC	Polycarbonate
P/C	Pilot and Copilot
PDM	Programed Depot Maintenance
P/FFLABORT	Primary Failure Discovered After Flight Abort
P/FGRABORT	Primary Failure Discovered After Ground Abort
PFP	Production Flat Pattern
POMO	Production Oriented Maintenance Organization
PP	Procurement and Production
PPG-LM	PPG-Liner Material
PPG	Pittsburg Plate Glass Industries
PSC	Packaging and Shipping Costs
PVB	Polyvinyl Butyrl
Q/C	Quality Control
(R)	Right-Hand Side
RAM	Reliability and Maintainability Program
RI/LAD	Rockwell International/Los Angeles Division

ROK	Recheck OK
R&R	Repair and Reclamation
RRS	Repair and Reclamation Shop
SA	Stretched Acrylic
SDCC	Scored, Scratched, Delaminated, Crazed, and Cracked
SRC	Specialized Repair Costs
S-900	Sierracin Transparent Material
SRD	Steel Rule Die
S/S	Shipset
TCTO	Technical Compliance Technical Order
TO	Technical Order
TT	Task Time
UCLA	University of California at Los Angeles
UMA	Unscheduled Maintenance Actions
USAF	United States Air Force
WBS	Work Breakdown Structure
W/S	Windshield
WUC	Work Unit Code

ALCS	Air Logistic Centers
OC-ALC	Oklahoma City ALC, Tinker Air Force Base, Oklahoma
OO-ALC	Ogden ALC, Hill Air Force Base, Utah
SA-ALC	San Antonio ALC, Kelly Air Force Base, Texas
SM-ALC	Sacramento ALC, McClellan Air Force Base, California
WR-ALC	Warner Robins ALC, Warner Robins Air Force Base, Georgia

SUMMARY

Rockwell International developed a series of design improvement options for transparency systems of aircraft in the current Air Force inventory. This work was accomplished under Air Force contract F33615-77-C-3060 and the original portion was documented in AFFDL-TR-78-153, volumes I through III. The objective of the study was to identify the high-cost, high-maintenance transparency components, identify cause of failures, and recommend corrective programs to reduce the cost of ownership to the Air Force Logistics Command.

On 12 February 1979, a follow-on study was added to the same contract with the same objective as the original study. The following aircraft were examined under the follow-on study:

- F-4 Fighter
- A-7D Fighter
- C-130 Cargo/transport
- CH-53 Cargo/helicopter
- CH-3 Cargo/helicopter
- UH-1F/P Utility/helicopter

This report documents the follow-on study. It contains the procedures and the analysis utilized in the identification and development of the design improvement options. Each proposed design improvement option is preceded by the rationale used in the selection process followed by a detailed cost-effectiveness trade study.

The following conclusions resulted from the follow-on effort:

1. The AFM 66-1 Data File, data obtained from ALC's and from field audits, etc, do provide a data base from which predominant transparency maintenance problems can be identified and the life cycle cost (LCC) impact determined.

2. Applying state-of-the-art technique design changes can be incorporated that will alleviate these maintenance problems. Those changes that are cost effective can be selected by LCC considerations.

3. It is concluded from this study that the cost savings for the indicated aircraft (refer to table 1) can be realized.

The proposed options as listed in table 1 represent a portion of all the design improvement candidates that were reviewed. During the selection process, various candidates were discarded because problem areas were not considered to be as critical or the potential cost savings were not considered to be as great as the selected options. In some cases, the candidate changes lacked sufficient data to be considered a viable option.

(With the initiation of an engineering change proposal for the A-7D aircraft canopy, the A-7D aircraft was eliminated from further consideration under this study.)

In the interest of expanding the search for cost reduction, it is recommended that the following studies be pursued at some future date.

RECOMMENDED FOLLOW-ON STUDIES

1. Offer special training programs for the care and proper handling of scratch-sensitive transparency components.

2. Provide a team of highly skilled technicians to buff and polish plastic-type windshields and canopies. This method of repair will reduce the number of replacement parts.

3. Incorporate solid-state anti-icing controllers to increase reliability and reduce replacement costs.

4. Incorporate the PPG-liner material in the secondary viewing and observation windows for helicopter-type aircraft. The improved resistance to abrasion will help maintain the desired optical qualities.

5. Incorporate the PPG-liner material for the stretched acrylic windshield and canopy for the A-7D aircraft. The improved resistance to abrasion will help reduce replacement parts and maintain the desired optical qualities.

TABLE 1

SUMMARY OF POTENTIAL COST SAVINGS FOR PROPOSED OPTIONS

	Annual Savings	
	Recommended Combination	Alternate Combination
F-4 AIRCRAFT		
Option No. 1 PPG-Liner Material Laminated Configuration for Improved Abrasion Resistance	$662,600	$662,600
Option No. 2 Improved Canopy Hinge Support Fittings	26,100	26,100
Total potential annual savings for F-4	$688,700	$688,700
C-130 AIRCRAFT		
Option No. 1 Improved Windshield Edge Sealing	$136,800	$136,800
Option No. 2 Windshield Edge Heater	37,700	37,700
Total potential annual savings for C-130	$174,500	$174,500
CH-53 HELICOPTER		
Option No. 1 Glass and PPG Liner Material for Pilot's and Copilot's Windshields	$ 45,300	
Option No. 2 Stretched Acrylic and PPG Liner Material for Center Windshield	$ 10,200	
Option No. 3 Windshield Frame Modification for Improved Sealing	$ 11,100	
Option No. 4 "Lube Blade" Windshield Wiper		20,900
Total potential annual savings for CH-53	$ 66,600	$ 20,900
CH-3 HELICOPTER		
Option No. 1 Glass and PPG Liner Material for Pilot's and Copilot's Windshields Option No. 2 Stretched Acrylic and PPG Liner Material for Center Windshield Option No. 3 Windshield Frame Modification for Improved Sealing	$ 48,900	
Option No. 4 "Lube Blade" Windshield Wiper		$ 23,300
Total potential annual savings for CH-3	$ 48,900	$ 23,300
UH-1F/P HELICOPTERS		
Option No. 1 "Lube Blade" Windshield Wiper	$ 10,600	$ 10,600
Total potential annual savings for all aircraft	$989,300	918,000

SECTION I

INTRODUCTION

INTRODUCTION

A considerable amount of the Air Force's funds allocated to operations and support activities is assigned to maintenance function. The maintenance function consumes vast amounts of manpower, spares, and material support costs. Approximately 25 percent of all Air Force personnel and well over half of the Air Force operations and support activities budget is directed at maintaining the Air Force fleet.

Although the "Transparency System" is a relatively small portion of the total air vehicle airframe and subsystems group, the 1977 annual expenditure for 20 selected study aircraft exceeds $5.5 million (reference 1). To further demonstrate the huge costs for maintaining transparency systems, a 10-year projection, adjusted for inflation and aircraft attrition, indicates that approximately $73 million dollars will be spent. In view of the large sums that are currently being expended in maintaining these transparency systems, this study is programed to develop cost-effective design and repair concepts (reference 1) aimed at reducing logistical support cost.

BACKGROUND

The original portion of the program was started 15 June 1977, and completed in December of 1978. The study was aimed at gathering and documenting the design and cost data for 20 study aircraft as listed in figure 1. In addition, the purpose of the study was to document the maintenance and logistical support activity, installation, and maintenance procedures that are currently being used at the Operational Bases and Air Logistics Centers

Reference 1. S. S. Brown, "Aircraft Transparency Failure and Logistical Cost Analysis, Volume I - Program Summary," AFFDL-TR-153 Air Force Flight Dynamics Laboratory, Wright-Patterson Air Force Base, Ohio 45433, December 1978.

BOMBERS
- B-52, B-57, AND FB-111

ATTACK
- A-7D AND A-37

CARGO/TRANSPORT
- C-5, C-9, C-130, C/KC-135, AND C-141

FIGHTERS
- F-4, F-15, F-105, AND F-111

TRAINERS
- T-37, T-38, AND T-39

OBSERVATION/UTILITY
- O-2 AND OV-10

HELICOPTERS
- CH-3, CH-53, AND UH-1

Figure 1. Study Aircraft

(reference 2). The intent of the study was to expand the research of transparency problems in greater depth, identify and recommend changes to maintenance procedures, and recommend design improvements that will reduce failures and maintenance cost. These proposed changes and some of the selected corrective programs can be found in reference 3.

The original study was programed to identify and develop five design improvement trades. In view of the substantial cost savings that resulted, the Air Force elected to increase the study of the other aircraft listed in figure 1. On 12 February 1979, a contract extension F33615-77-C-3060, P00004, requesting design improvement corrective programs for additional aircraft was authorized. The supplementary study authorized the further review of the F-4, C-130, A-7D, CH-53, CH-3, and UH-1 aircraft.

BASIS FOR STUDY SELECTION

The selection process utilized in the establishment of the corrective programs during the review of the 20 study aircraft (figure 1) was to identify those aircraft having the highest annual expenditure in maintenance of transparency systems. As the search progressed, it became apparent that other factors had to be considered, in identifying aircraft to be analyzed. Consequently, it was decided to categorize the study aircraft. The categories established were aircraft:

1. Having the highest annual expenditure in the maintenance of transparency systems

2. Maintaining an important position in the total posture of the Air Force inventory

Reference 2. S. S. Brown, "Aircraft Transparency Failure and Logistical Cost Analysis, Volume II - Design Data and Maintenance Procedures," AFFDL-TR-78-153 Air Force Flight Dynamics Laboratory, Wright-Patterson Air Force Base, Ohio 45433, December 1978.

Reference 3. S. S. Brown, "Aircraft Transparency Failure and Logistical Cost Analysis, Volume III - Transparency Analysis," AFFDL-TR-78-153 Air Force Flight Dynamics Laboratory, Wright-Patterson Air Force Base, Ohio 45433, December 1978.

3. Having ongoing or recent modification programs of transparency systems

4. Having unique maintainability problems

5. Being phased out of Air Force inventory

The five study aircraft selected in the original study considered one or more of these categories plus the consideration that the aircraft service life would extend into the next 10-year timespan.

During the course of the data collection and analysis phases, it was also ascertained that a number of study aircraft were already involved in ongoing transparency modification or replacement programs. For example, the F-111 series aircraft were being retrofitted with birdproofed windshield and canopy hatches. The F-15 aircraft were likewise being refurbished with a revised (acrylic type) windshield side panel and canopy transparencies. In the cargo-type aircraft, it was determined that an improved windshield panel was placed in the C-135 spares inventory. Because of these modification programs, these study aircraft were eliminated from consideration.

Utilizing the above approach, the aircraft selected to be investigated in the Supplemental Study was in Categories 1, 2, and 4. Both the fighter-type F-4 series and A-7D aircraft are experiencing in excess of two dollars per flight hour as shown in table 1, "Annual Transparency System Logistical Support Costs", Reference 1. The C-130 series aircraft is operating approximately one dollar per flight hour, but results in an annual expenditure of close to 350,000 dollars per year.

The helicopters were selected on the basis of having an average operating cost of approximately three dollars per flight hour. Category 4 was an important factor for the helicopters, in that extreme scratching principally due to windshield wipers is causing very high replacement rates.

It is for these reasons that these aircraft were selected for the Supplementary Study.

SECTION II

PROGRAM OBJECTIVES AND REQUIREMENTS

PROGRAM OBJECTIVES

The objective of the original study was to reduce maintenance and logistical support costs of selected transparency systems. It was accomplished by conducting a detailed study of the reliability, maintainability, and logistical support characteristics of the study aircraft. The approach utilized was to identify the high-maintenance cost system components, conduct an in-depth failure analysis, define the most significant design parameters affecting cost, and finally, recommend corrective programs to achieve significant savings in life cycle costs.

This supplemental study therefore concentrates on the continued identification of design improvement candidates for the following specific aircraft.

- F-4 fighter
- A-7D fighter
- C-130 cargo/transport
- CH-53 cargo/helicopter
- CH-3 cargo/helicopter
- UH-1F/P utility helicopter

The analysis contained herein primarily utilized the data base collected and developed for the original portion of the program (references 1, 2, and 3). In order to ensure that current inputs and trends related to the transparencies of the respective aircraft, additional data were collected to update the data base. The additional data were gathered through direct visitation or by telecommunication. The organizations and facilities contacted were as follows:

Operational Air Force Bases

- 1550th ATTW - Kirtland AFB - Albuquerque, New Mexico
- 463rd TAW - Dyess AFB - Abilene, Texas
- 146th TAW - California ANG - Van Nuys, California
- 302-SOS - Luke AFB - Phoenix, Arizona

Air Logistics Centers

- Ogden ALC - Hill AFB - Ogden, Utah
- Oklahoma City ALC - Tinker AFB - Oklahoma City, Oklahoma
- Warner Robins ALC - Warner Robins AFB, Georgia

Transparency Suppliers

- Goodyear Aerospace Corp, Arizona Division - Litchfield Park, Arizona
- Sierracin/Sylmar - Sylmar, California
- Tex Star Plastics - Grand Prairie, Texas
- Dupont - Plastic Products - Wilmington, Delaware
- Swedlow Incorporated - Garden Grove, California
- PPG Industries - Huntsville, Alabama

Others

- Continental Airlines - Maintenance Facility - Los Angeles, California
- Technical Heaters, Inc - San Fernando, California
- Naval-Aviation Supply Office - Philadelphia, Pennsylvania

TRANSPARENCY/SUPPORT SYSTEMS

The definition of transparency systems, as considered in this study, is listed in figure 2. They include three categories:

1. Transparency components
2. Interactive support systems
3. Support structures

COMPONENTS

1. WINDSHIELDS
2. CANOPIES
3. WINDOWS

INTERACTIVE SUPPORT SYSTEMS

1. ANTI-ICING
2. DEFOGGING
3. RAIN REMOVAL
4. OPERATING AND ACTUATION
5. PRESSURIZATION

SUPPORT STRUCTURES

1. FRAMES
2. POSTS
3. LONGERONS & SILLS

Figure 2. Aircraft Transparency Systems

The transparency components consist of the primary elements of windshield panel assemblies, canopy transparency and frame assemblies, and cabin windows. The interactive support systems include only the major components of the subsystem. For example, sensors, bus bars, controllers, and toggle switches for anti-icing systems are included, integral and adjacent ducts, diffusers, and control valves for defogging; actuators, links, and latches are also included. Ancillary items such as wiring, switches, tubing, etc, are not included. Support structure consists of only those members that form an edge member, adjacent contact with edge member, or part of a frame assembly.

PROGRAM REQUIREMENTS

The main thrust of the supplemental study was the identification of additional corrective programs for the F-4, A-7D, C-130, CH-53, CH-3, and UH-1 aircraft. The selection of potential design improvement candidates for these corrective programs were generally initiated from failure analysis as extracted from the AFM 66-1 maintenance data collection system (Reference 4) or some known problem area identified from field visits. Another keying factor was the cost of maintaining and providing spares for the study transparencies. The general sequence of steps to develop the corrective program is to:

1. Conduct a failure analysis.

2. Develop design improvement candidates.

3. Collect and assemble cost analysis data.

4. Develop cost-effective trade study.

Reference 4. MDCS, Air Force Manual 66-267, "Equipment Maintenance - Maintenance Data Collection System," Department of the Air Force, Headquarters U.S. Air Force, Washington, DC 20330.

FAILURE ANALYSIS

The basis used in the development of failure analysis was primarily through the extraction of maintenance data from the AFM 66-1 data tapes using the Maintenance Analysis Model (MAM's) Program as described in Reference 3. The output of MAM's is a computer program tabulation containing the maintenance man-hours, logistical costs, and AFM 65-110 ("L-card" data) listing the number of flights, and total number of flight hours flown. The tabulation by the appropriate Work Unit Code (WUC) also provides listing of the How-Malfunctioned codes (type of failure), when discovered code, and action taken code (description of repair). To further highlight the nature of the problem, the WUC, How-Mal can be ranked as a function of maintenance hours or logistical support costs.

Another important source of failure modes comes from the field. These data have been collected during the field audits of the Operational Base and from the ALC. It is believed that unique problems do not always fit the descriptors contained in the WUC -06 manual. It is for this reason that field contacts are highly beneficial as supplementary sources of information.

By the utilization of the combination MAM's and field audit notes, the failure modes can be identified and rationalized. From these data, an assessment as to how the component or the part failed was condensed in the form of a failure fault tree, and failure summary of the more significant How-Mal action taken, and cause of probable failure. The fault trees and failure analysis summaries are shown in the Design Improvement Trade Studies, Section III through Section VIII.

The initial data source utilized in the development of the fault trees was the MAM's printout. As previously explained, the MAM's printout contains the listing of maintenance hours, logistical support costs, failure modes, etc. A sampling of these data is contained in Appendix A. Since each MAM's printout may contain 20 to 200 pages for each transparency system, it was decided to limit the printout as contained in Appendix A to the selected work unit codes.

DESIGN IMPROVEMENT CANDIDATES

The selection of design improvement candidates is largely responsive to the failures that were noted in MAM's and to a large extent to problems which surfaced at the field level. In most cases, these problems are common in both data sources.

The development of the corrective programs was accomplished by personnel highly experienced in the area of transparency design. To ensure that the very best of design data and material characteristics were obtained, a very heavy reliance on the transparency suppliers for backup support was made. The procedures and evaluation process for the development of corrective programs are contained in Sections II and IV of Reference 3.

A ground rule that was carefully exercised in the selection of candidate improvements was to ensure that the proposed improvements would result in a minimum modification to the existing configuration. With the complexity of the equipment contained in the interior of the modern aircraft, a very important factor was to avoid the domino effect of causing other related (unknown) changes. This effect could possibly negate the cost reduction anticipated for the selected design improvements.

During the course of the review of the failure modes and design parameters instrumental in establishing the transparency configuration, it became apparent that one or more solutions could be considered. These alternates are presented as options that can achieve the desired cost reduction objectives. Various other alternatives that lack sufficient information or could not be fully developed are discussed in Section IX, "Conclusions and Recommendations," and listed as potential follow-on studies.

COST ANALYSIS

The cost analyses performed in support of the trade studies presented herein utilize the costing data extracted from the AFM 66-1 MDCS and the K051

"Increased Reliablity of Operational Systems" (IROS), Reference 5. At the start of this study, the ALC was contacted to provide an update of the maintenance activity for each of the study aircraft. The data requested included a listing of the expenditure of maintenance hours, spares procurement, and update of unit costs. The two data sources provide the data basis for those trade studies.

The cost analyses generated for each trade study are based on a 10-year life cycle projection. The means of accounting for the escalation that will occur during this timespan is obtained from the USAF "Cost and Planning Factors," Reference 6.

TRADE STUDIES

The structuring of the trade studies to determine the cost effectiveness of the selected design improvement studies was accomplished in two steps. Step 1 was to collect and assemble the current costs for the existing concept and to develop and apply the appropriate factors for projection of a 10-year lifespan. Step 2 was the estimation of the redesign and development costs for the revised configuration. To this estimate, the determination of reduced maintenance was established to ascertain the net life cycle cost savings.

The trade studies for each aircraft are presented in the form of design improvement options. The options were selected from a listing of candidate improvements developed from the failure analysis. The candidate design improvements that offered the greatest potential for cost reduction were designated design improvement options; the remaining were categorized as recommended studies warranting further investigation.

Reference 5. IROS, "Increased Reliability of Operational Systems," K051, AFLC/AFSC Pamphlet 400-11, Department of the Air Force, Headquarters, Air Force Logistics Command (AFLC) Wright-Patterson Air Force Base, Ohio 45433, Headquarters, Air Force Systems Command (AFSC) Andrews Air Force Base, DC 20334, 16 August 1974.

Reference 6. Department of the Air Force, "USAF Cost and Planning Factors," AFR 173-10, Volume I (C6), Attachment 49, 2 May 1977, Table 49, Headquarters, U.S. Air Force, Washington, DC 20330, 6 February 1975.

IMPROVEMENT TRADE STUDIES

The trade studies for the subject aircraft transparency systems are presented in Sections III through VIII of this document. Each of these sections contains a description of the configuration, failure analysis, and a rationale for the selection of the candidates. From these data, the proposed design improved options are defined and followed by an LCC cost analysis specifying the resulting cost savings.

SECTION III

F-4 TRANSPARENCY SYSTEM DESIGN

IMPROVEMENT TRADE STUDY

CONFIGURATION DESCRIPTION

The F-4 transparency configuration consists of a windshield assembly and two independently operated canopies, one for the pilot and the other for the Weapons Control Officer. With the exception of the center windshield panel laminated glass assembly, the remaining windshield and canopy transparent panels are stretched acrylic. The support systems include windshield anti-icing, rain removal, and cockpit pressurization provisions. Figure 3 shows the installed transparency systems being evaluated herein.

FAILURE ANALYSIS

A failure analysis of the F-4 transparency system was conducted utilizing the maintenance analysis model (MAM's) program. The failure mode descriptors in combination with flight hours, maintenance hours, and logistical cost are contained in the sampling MAM's tabulations shown in figure A-1 of Appendix A. Since the MAM's printout for the F-4 aircraft contains 175 pages, it was decided to only include sample pages for the work unit codes for the selected candidate improvements.

An assessment of the component failures from the MAM's was made. These were condensed in the form of a failure fault tree (figures 4 and 5) and a failure analysis summary (figures 6 and 7) of the more significant How-Mal's, action taken, and probable cause.

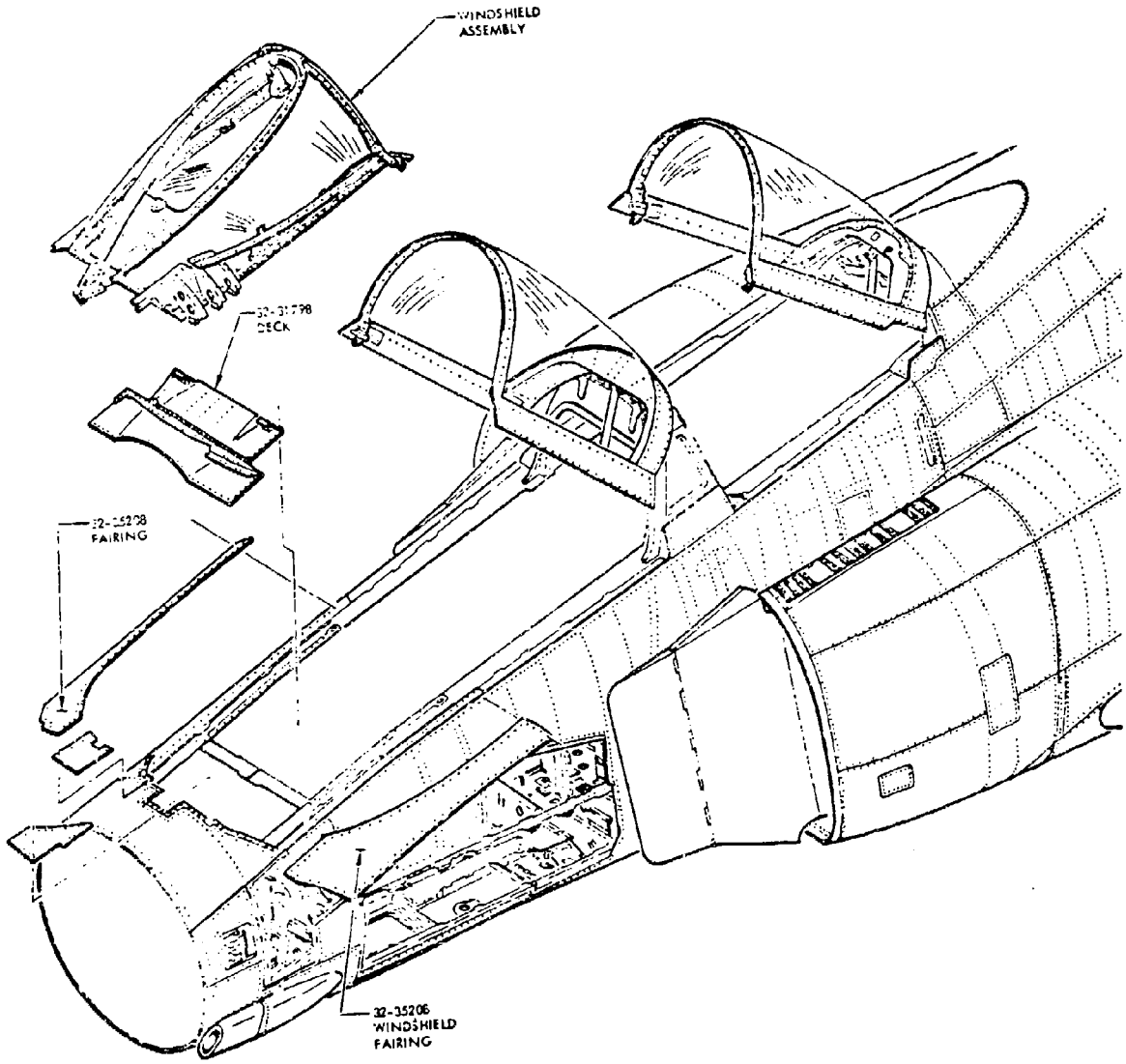

Figure 3. F-4 Transparency Configuration

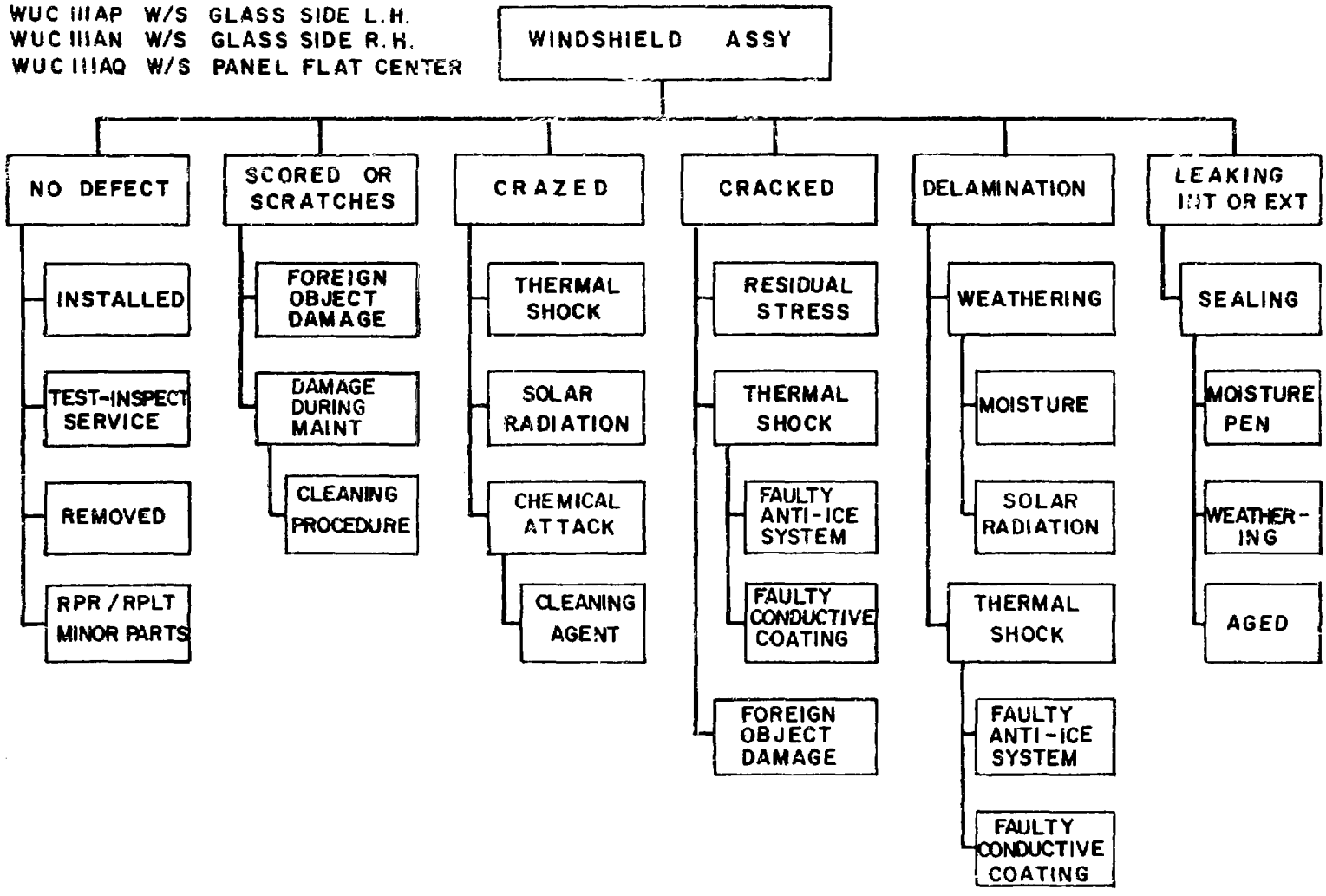

Figure 4. Fault Tree F-4 Windshield Assembly

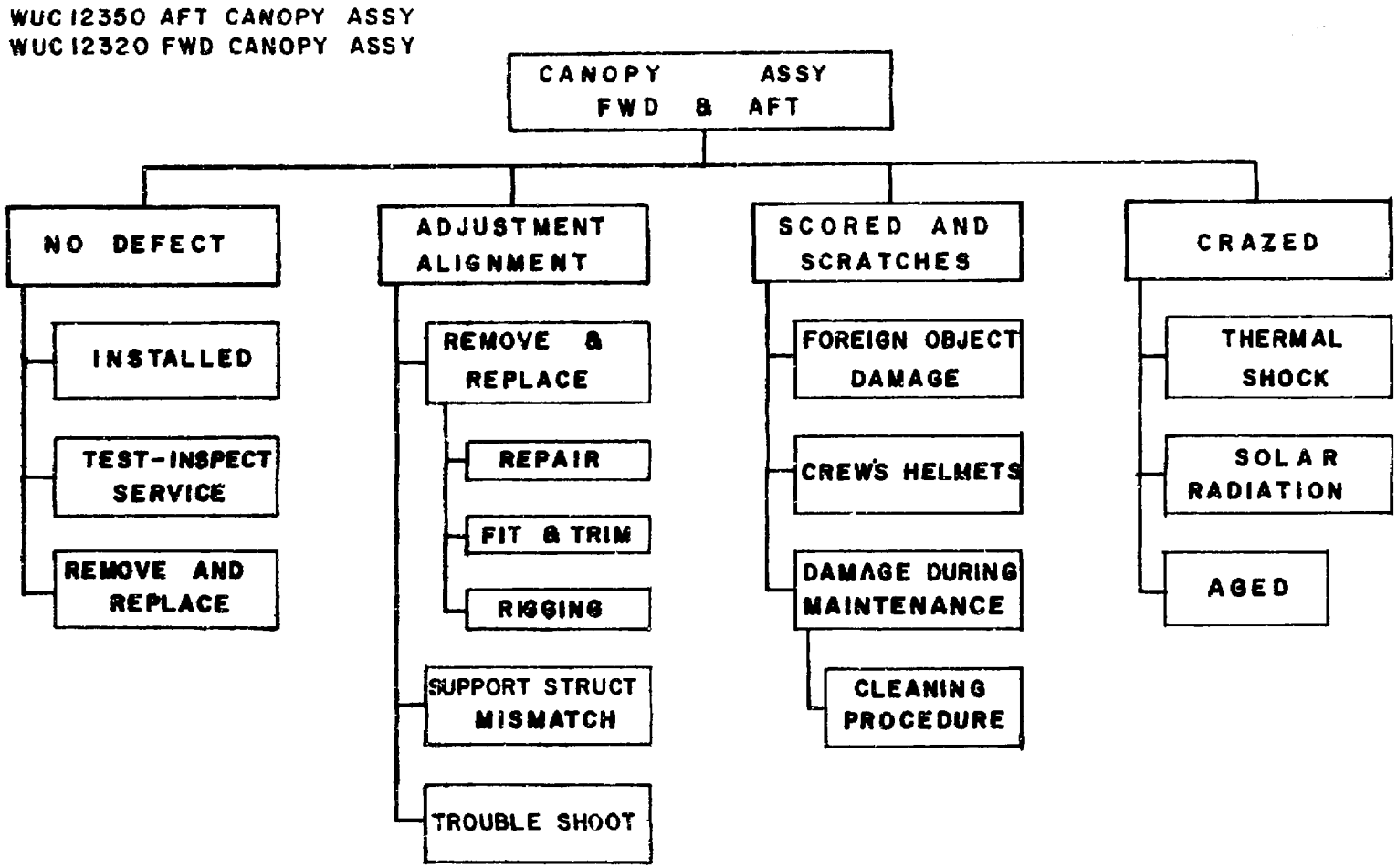

Figure 5. Fault Tree F-4 Forward and Aft Canopy Assemblies

WUC 111AP WINDSHIELD GLASS SIDE L.H.
WUC 111AN WINDSHIELD GLASS SIDE R.H.
WUC 111AQ WINDSHIELD PANEL FLAT CENTER

HOW MAL	ACTION TAKEN	PROBABLE CAUSE
799 - NO DEFECTS	Q - INSTALLED X - TEST-INSPECT-SERVICE H - EQUIP CHECK NO RPR REQUIRED P - REMOVED	*INTERRELATED WITH OTHER HOW MAL CODES
935 - SCORED OR SCRATCHES	R - REMOVE AND REPLACE P - REMOVED Q - INSTALLED G - RPR/RPLT MINOR PARTS	* FOREIGN OBJECT DAMAGED *DAMAGED DURING MAINTENANCE
605 - CRAZED	R - REMOVE AND REPLACE P - REMOVED G - RPR/RPLT MINOR PARTS Q - INSTALLED	*THERMAL SHOCK *SOLAR RADIATION *CHEMICAL ATTACK
190 - CRACKED	G - RPR/RPLT MINOR PARTS P - REMOVED R - REMOVE AND REPLACE Q - INSTALLED	*RESIDUAL STRESS *THERMAL SHOCK * FOREIGN OBJECT DAMAGE
846 - DELAMINATION	R - REMOVE AND REPLACE P - REMOVED G - RPR/RPLT MINOR PARTS Q - INSTALLED	*WIATHERING *THERMAL SHOCK
381 - LEAKING INT OR EXT	G - RPR/RPLT MINOR PARTS Q - INSTALLED R - REMOVE AND REPLACE	*SEALING

Figure 6. F-4 Windshield Panel Assembly Failure Analysis Summary

WUC 12350 AFT CANOPY ASSY
WUC 12320 FWD CANOPY ASSY

HOW	ACTION TAKEN	PROBABLE CAUSE
799 - NO DEFECTS	Q - INSTALLED	*INTERRELATED WITH OTHER HOW-MAL CODES
	X - TEST-INSPECT-SERVICE	
	P - REMOVED	
127 - ADJUSTMENTS & ALIGNMENT	L - ADJUST	*SUPPORTING STRUCTURES OUT OF TOLERANCE
	G - REPAIR/REPLACEMENT MINOR PARTS	*CUSTOM FIT
	Y - TROUBLESHOOT FITTING & RIGGING	*NOT ENOUGH ADJUSTMENT
935 - SCORED AND SCRATCHES	R - REMOVE & REPLACE	*DAMAGED DURING MAINTENANCE
	P - REMOVED	*CLEANING PROCEDURE
	G - REPAIR/REPLACEMENT OF MINOR PARTS	*FOREIGN OBJECT DAMAGEDS
	A - BENCH CHECK AND REPAIR	
605 - CRAZED	R - REMOVE AND REPLACE	*THERMAL SHOCK
	P - REMOVED	*SOLAR RADIATION
	Q - INSTALLED	*AGED
	G - REPAIR/REPLACEMENT OF MINOR PARTS	

Figure 7. F-4 Canopy Assembly Failure Analysis Summary

CANDIDATE DESIGN IMPROVEMENTS

Examination of the failure analysis data and results concluded that the following candidate improvements should be considered and investigated.

1. Incorporate a protective hard coating for reduced scratching and abrasion.

2. Incorporate a laminated configuration consisting of an inner and outer protective layers for improved abrasion resistance.

3. Incorporate improved canopy-to-fuselage attachment fitting to reduce the hours required to remove and replace the canopy assemblies.

4. Modify the windshield center panel support frame to reduce cracking.

5. Improve training procedures to effect reduced scratching attributed to ground handling personnel.

INVESTIGATION AND RATIONALE FOR SELECTED CANDIDATES

CANDIDATE 1 - WINDSHIELD AND CANOPY PROTECTIVE HARD COATING

The MAM's indicate that approximately 30 to 40 percent of the maintenance hours expended can be attributed to How-Mal code scored or scratched, etc. It was hoped that a new protective coating for application to stretched acrylic (S/A) transparent panels would be available. Calls to five transparency suppliers indicated that coatings for S/A were available, but that they offer minimal improvement in outer surface protection. They also stated that if the coating were scratched, the process of buffing and polishing could not be used as a means of repairing the transparency. As a result, this candidate was dropped.

CANDIDATE 2 - PPG-LINER MATERIAL, LAMINATED CONFIGURATION FOR IMPROVED ABRASION RESISTANCE

In view of the large number of the F-4 series in the Air Force, Navy, and allied military forces inventory, the inclusion of a revised laminated configuration to reduce the scoring and scratching appears to be feasible. It was further ascertained that the Navy is contemplating a modification to extend the service life of the F-4. It is therefore concluded that this aircraft will be in inventory for at least the next decade. On this basis, the incorporation of a new transparency configuration and material was considered to be cost effective. A review of the materials available for this application was made that considered such factors as:

1. Resistance to abrasion

2. Cost impact

3. Producibility

4. Availability

5. Optical qualities

6. Resistance to environmental and weathering factors

As a result of the materials review it was ascertained that PPG Industries is currently developing a new urethane material which should be an improvement over the abrasion resistance of the current plastic glazing materials. This new PPG-"liner material" can be applied to the inboard and outboard surfaces of acrylic and polycarbonate materials. Although the material characteristics are based on laboratory test of prototype production of the material, PPG indicated that incorporation of the PPG-liner material should result in significant increases in service life, at a fabrication cost increase that will result in overall cost effectiveness of the proposed configuration. It is concluded that the desired reduction in maintenance costs, while retaining the required optical qualities, etc, can be best achieved with a newly developed material such as that being developed by PPG Industries.

CANDIDATE 3 - IMPROVED CANOPY HINGE SUPPORT FITTINGS

Approximately 23 percent of the maintenance hours for both the forward and aft canopies were attributed to WUC 127, improper adjustment and alignment. Repair personnel at the ALC indicated that significant hours were being expended in the fitting and rigging process of removing and replacement of canopies after repair. Initial estimates indicated that significant savings in cost can be achieved.

CANDIDATE 4 - MODIFIED WINDSHIELD CENTER PANEL SUPPORT FRAME

Initial examination of this potential problem listed a 30 percent expenditure of the total hours attributed to maintaining the flat windshield center panel was due to induced cracks, especially at the edges of the glass panel. It was believed that this was caused by improper fitting of the support frame assembly. Discussions with the ALC indicated that most of the cracks or pitting were attributed to runway FOD and not the frame support. For this reason, this proposed fix was dropped.

CANDIDATE 5 - IMPROVED TRAINING PROCEDURES

It has been stated that 90 percent of the scratching and abrasions can be attributed to ground handling by both the flight crews and maintenance personnel. Since this problem is difficult to quantify in terms of absolute and meaningful cost savings trades, it is highly recommended that a specialized "training-type" program be implemented to help minimize the damage incurred to the transparent panels.

SELECTED TRADE STUDIES

The candidates selected as being cost-effective design improvements are:

1. Incorporation of a laminated PPG-liner material for the windshield side panels, forward and aft canopies

2. Incorporation of improved canopy hinge support fittings to reduce fitting and rigging maintenance costs

These candidates are presented as options recommended for incorporation into the F-4 transparency system.

PROPOSED DESIGN OPTIONS

OPTION 1 (CANDIDATE 2 - PPG-LINER MATERIAL LAMINATED CONFIGURATION FOR IMPROVED ABRASION RESISTANCE)

The high cost of maintaining the F-4 transparency system is primarily attributed to scratches and abrasions the side windshield, and to both the forward and aft canopy panels. Although a substantial amount of the abrasion that results in degraded optics is attributed to weathering factors, the major contributor to this type of failure is caused by the improper handling procedures by both the flight and ground crews.

Data obtained from the AFM 66-1 MDC, and collected from the ALC, indicates that more than 50 percent of the maintenance hours are expended in the removal, repair, and replacement of these transparents. The degradation of the optical qualities requires the replacement of each canopy component at a rate in excess of 20 per month (reference 7). It is for this reason that a multi-laminated configuration incorporating the PPG-liner material is proposed. (See figures 8 through 10.)

Reference 7. G. Rasmussen, Act. Chief Avionics/Software Sec Dir of Mat Mgt, MMSRH, "Acquisition of Logistical Support and Cost Data for the F-4 Windshield and Canopy System (Your Ltr, 73A-0174)" MMSRH, Department of the Air Force, Headquarters Ogden Air Logistics Center (AFLC), Hill Air Force Base, Utah 84056

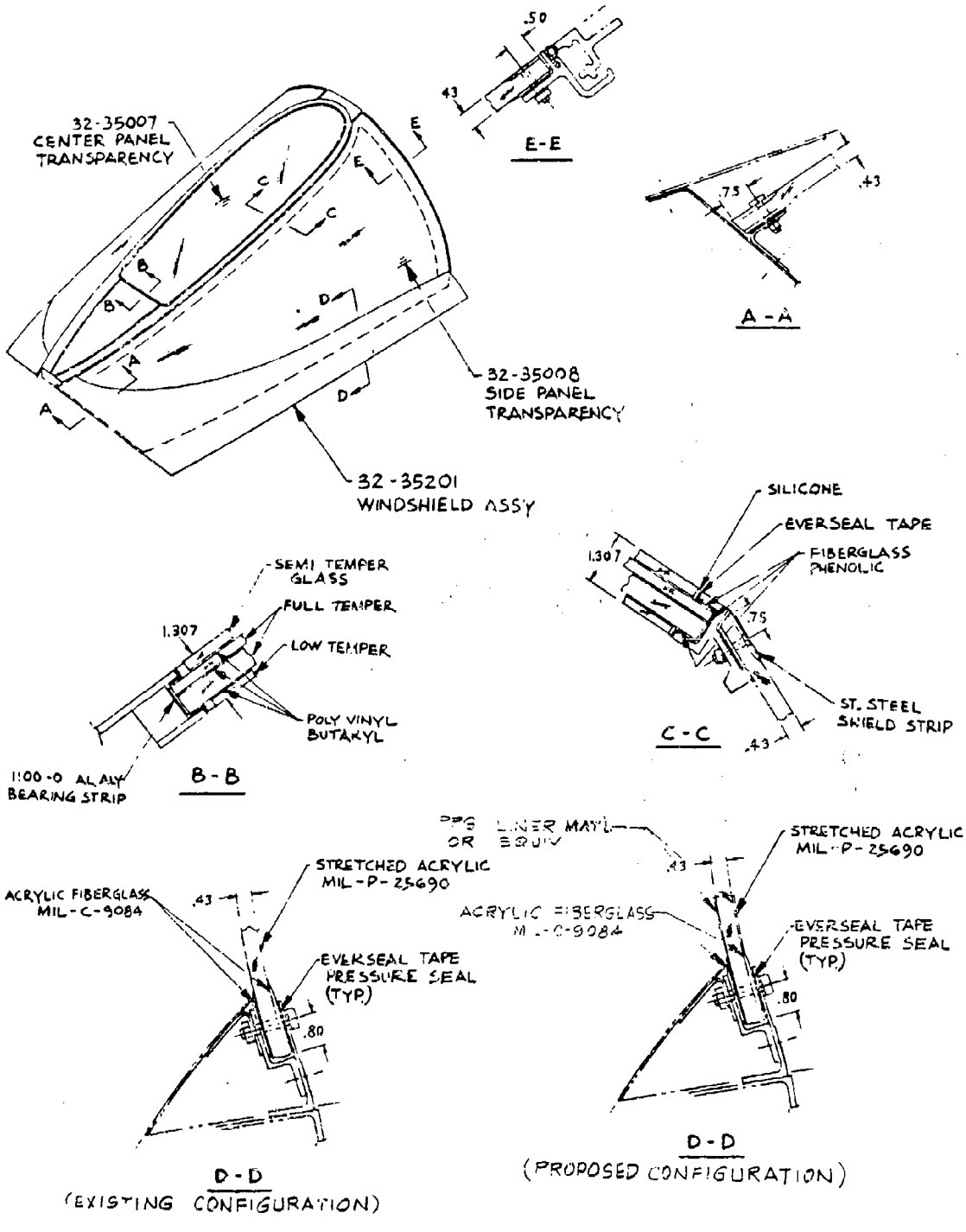

Figure 8. F-4 Windshield Assembly

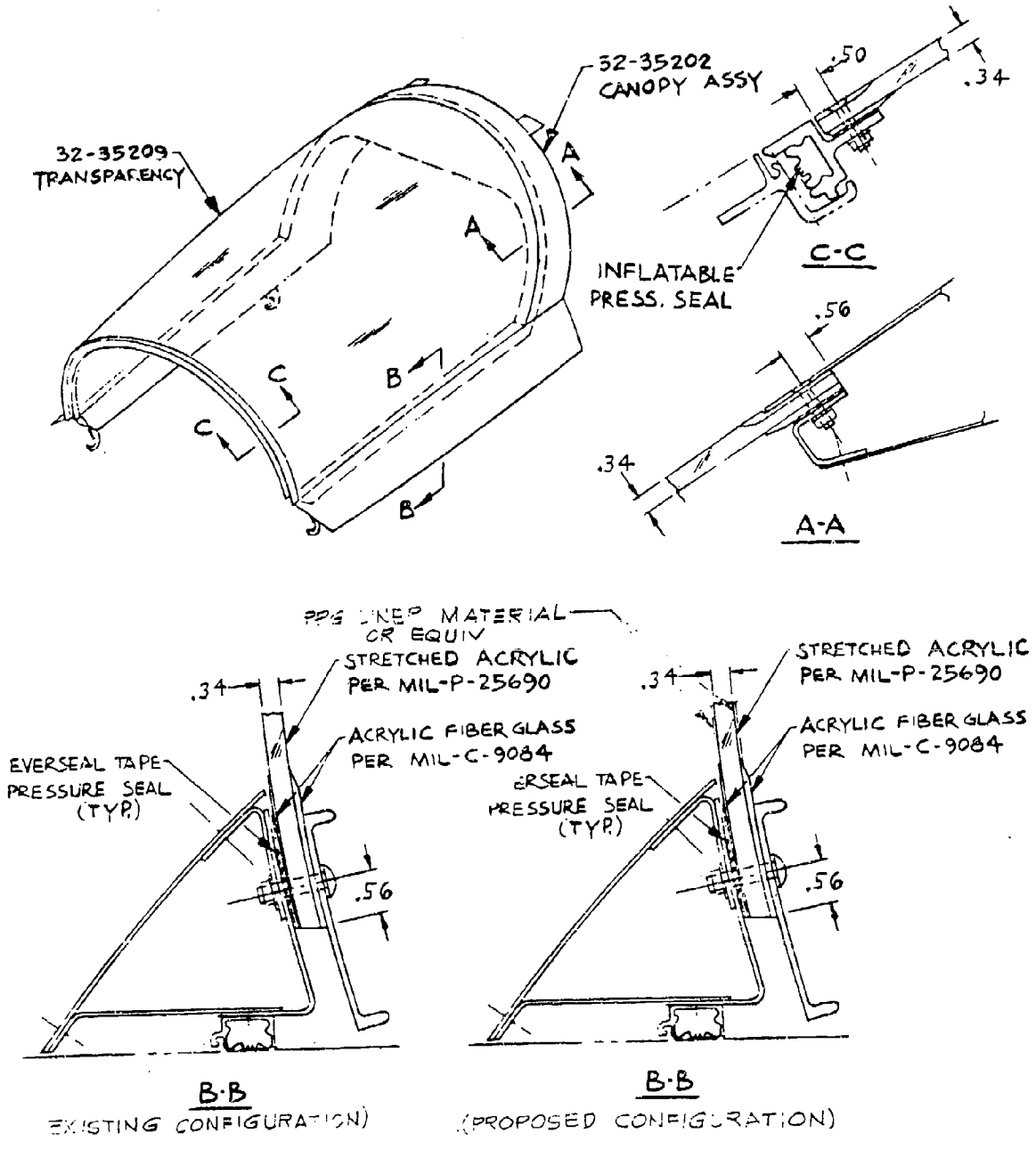

Figure 9. F-4 Forward Canopy Assembly

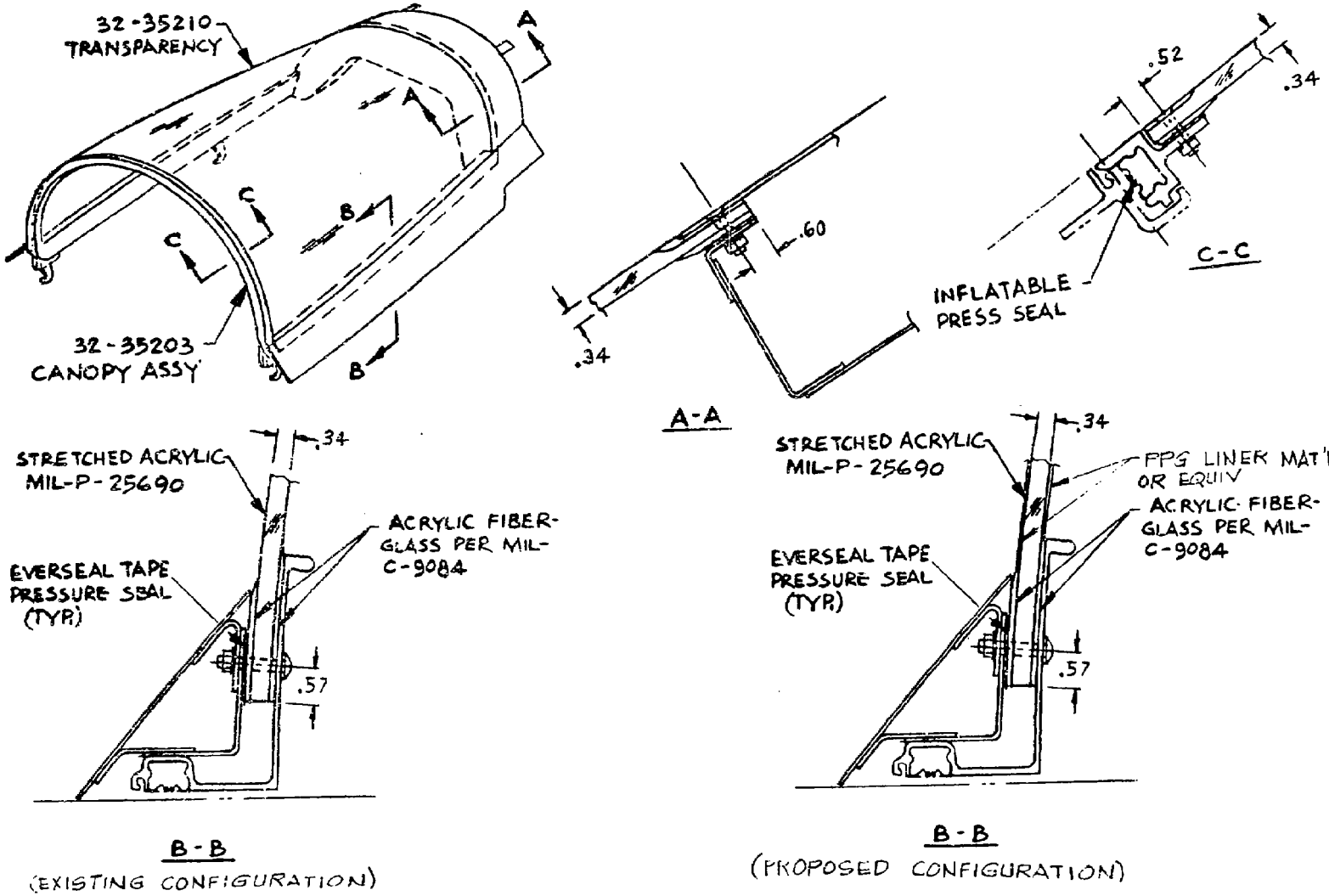

Figure 10. F-4 Aft Canopy Assembly

The current configuration of the side and canopy transparent panels are monolithic stretched acrylic. The respective panel thicknesses of 0.43 and 0.34 inch are established by the requirements for optical qualities, birdstrike protection and cockpit pressurization. As previously stated, the PPG-liner material is believed to provide an improved abrasion resistance of the inner surface by a factor of 3 to 4 for an inner liner, and 2 to 2-1/2 for both an inner and outer liner.

To utilize the advantages of this material, the proposed modification as depicted in figure 11 will incorporate a 0.020-inch PPG-liner material bonded to both the outside and inside surfaces of the stretched acrylic structural ply. The edges will be tapered to feather to the juncture of the existing frame assembly and be sealed to prevent delamination and peeling (see figures 8 through 10). The structural ply will retain its existing thicknesses of 0.43 and 0.34 inch to maintain structural integrity. This approximate increase in the weight for all three components is 13 pounds (see figure 11). PPG indicated that, based on their experience in fabrication techniques on prototype specimens, the PPG "liner material" can be readily formed to the F-4 transparency contours.

OPTION 1 - PPG-LINER MATERIAL LAMINATED CONFIGURATION FOR IMPROVED ABRAISION RESISTANCE

Item	Existing design			Proposed configuration		Weight penalty (lb)
	Area* ($in.^2$/AV)	Config & thickness (in.)	Wt (lb)	Config & thickness (in.)	Wt (lb)	
Windshield (side)	1,610	0.43 S/A	29.8	0.02 PPG-LM 0.43 S/A 0.02 PPG-LM	32.5	2.7
Fwd canopy	2,720	0.34 S/A	39.8	0.02 PPG-LM 0.34 S/A 0.02 PPG-LM	44.4	4.6
Aft canopy	2,695	0.34 S/A	39.4	0.02 PPG-LM 0.34 S/A 0.02 PPG-LM	44.0	4.6

*Total panel area
Approximate total panel vision areas:

Windshield - 1,080 $in.^2$

Fwd canopy - 2,030 $in.^2$

Aft canopy - 1,901 $in.^2$

AV = air vehicle
S/A = stretched acrylic
PPG-LM = PPG urethane liner material

PPG liner material concept for side windshield (forward and aft canopies), assuming ftu at 2,000 psi Urethane and 13,200 psi S/A

OPTION 2 - IMPROVED CANOPY HINGE SUPPORT FITTING

Negligible weight change

Figure 11. - F-4 Transparency Design Data.

Cost Analysis

The estimated annual savings for the incorporation of the multilaminate PPG-liner material is $662,600. This saving is based on a 10-year life cycle cost timespan. The methods utilized in establishing the costing data for this modification is detailed in table 2. The first step in the development of the cost trades was to obtain an update of the unit costs, maintenance hours expenditure, and determine spare component replacement rates (reference 7). The update as supplied by the ALC was for the 1978 12-month timespan. During this time, repair and overhaul records for both components were received from field-level and programed-depot maintenance (PDM). The combined replacement rate of approximately 22 forward units and 22 aft canopy units corresponded with data collected during the 1976 to 1977 time period of the original study, and was consequently used as the basis for projections of current maintenance activity projections. It should be noted that these replacement totals do not include 47 canopies that were polished and buffed.

The second step was to project costs for redesign and development of the PPG-liner concept. This was accomplished with the use of costing factors as provided by PPG Industries. These factors were applied to the unit costs provided by the ALC, and adjusted for inflationary escalation as noted in reference 7.

Option 1 and Option 2 can be combined for a total annual savings of $688,700.

TABLE 2. COST ANALYSIS

F-4 TRANSPARENCY SYSTEM

OPTION 1 - PPG-LINER MATERIAL, LAMINATED CONFIGURATION FOR IMPROVED ABRASION RESISTANCE

Summary

Present Concept	
Field maintenance	$ 8,165,115
Spares	6,972,210
Total F/M and spares, 10-year LCC	$15,137,325
Redesign Concept	
Redesign and development	$ 800,000
Field maintenance	3,991,050
Spares	3,720,420
Total F/M spares, nonrecurring and recurring, 10-year LCC	$8,511,470
Net 10-year LCC cost saving	$6,625,855
Annual (average) saving	$ 662,600

TABLE 2. COST ANALYSIS (Continued)

F-4 TRANSPARENCY SYSTEM

OPTION 1 - PPG-LINER MATERIAL, LAMINATED CONFIGURATION FOR IMPROVED ABRASION RESISTANCE

Description		Unit Cost	Monthly Replacement Rate
WUC 111AP	LH W/S panel	$ 650	2
WUC 111AN	RH W/S panel	$ 610	2
WUC 1232A	Fwd canopy	$1,020	23
WUC 1235A	Aft canopy	$ 975	22

Annual Replacement Cost (Existing Concept)

Cost of Replacement Parts

LH W/S panel	2 x 12 x $ 650	=	$ 15,600
RH W/S panel	2 x 12 x $ 610	=	$ 14,640
Fwd canopy	23 x 12 x $1,020	=	$281,520
Aft canopy	22 x 12 x $ 975	=	$257,400
Total cost of replacement parts			$569,160

Removal and Replacement Cost

LH W/S panel	2 x 7 MH x $30/hr x 12	=	$ 5,040
RH W/S panel	2 x 7 MH x $30/hr x 12	=	$ 5,040
Fwd canopy	23 x 41.5 MH x $30/hr x 12	=	$343,620
Aft canopy	22 x 39.5 MH x $30/hr x 12	=	$312,840
Total removal and replacement cost			$666,540

Total annual F-4 maintenance cost for existing concept[1] $1,235,700

10-Year Life Cycle Cost

Cost of replacement parts = $569,160 x 1.225[2] x 10 =$ 6,972,210
Cost of removal and replacement
= $666,540 x 1.225 x 10 = $ 8,165,115

Total 10-year life cycle cost (existing concept) $15,137,325

(1) ALC data (reference 7)
(2) Escalation factors (reference 6)

TABLE 2. COST ANALYSIS (Continued)

F-4 TRANSPARENCY SYSTEM

OPTION 1 - PPG-LINER MATERIAL, LAMINATED CONFIGURATION FOR IMPROVED ABRASION RESISTANCE

Design and Development Cost

Design and costing factors - estimated by PPG Industries

Service life increase for application for both inner and outer surfaces, 2 to 2-1/2

Increased fabrication cost for application for both inner and outer surface, 1.5

Development Cost

Design and support	1,000 hours		
TCTO	400 hours		
Engineering =	1,400 hours x $40 =		$ 56,000
Engineering material		=	$ 2,000
Qualification		=	$500,000
Test		=	$200,000
Fabrication of test specimens		=	$ 42,000
Total development cost (nonrecurring)		=	$800,000

Unit Cost of Redesigned Transparent Components

LH W/S panel	= $ 650	x 1.5	= $ 975
RH W/S panel	= $ 610	x 1.5	= $ 915
Fwd canopy	= $1,020	x 1.5	= $1,530
Aft canopy	= $ 975	x 1.5	= $1,463

TABLE 2. COST ANALYSIS (Concluded)

F-4 TRANSPARENCY SYSTEM

OPTION 1 - PPG-LINER MATERIAL, LAMINATED CONFIGURATION FOR IMPROVED ABRASION RESISTANCE

Monthly Replacement Rates With PPG-Liner Material

LH W/S panel	2 x 0.50[3]	= 1
RH W/S panel	2 x 0.50	= 1
Fwd canopy	23 x 0.50	= 11
Aft canopy	22 x 0.50	= 11

Annual Replacement Cost (PPG-Liner Material)

Cost of Replacement Parts

LH W/S panel	1 x 12 x $ 975	=	$ 11,700
RH W/S panel	1 x 12 x $ 915	=	$ 10,980
Fwd canopy	11 x 12 x $1,530	=	$201,960
Aft canopy	11 x 12 x $1,463	=	$193,115
Total cost of replacement parts			$417,755

Removal and Replacement Cost

LH W/S panel	1 x 7 MH x $30/hr x 12	=	$ 2,520
RH W/S panel	1 x 7 MH x $30/hr x 12	=	$ 2,520
Fwd canopy	11 x 41.5 MH x $30/hr x 12	=	$164,340
Aft canopy	11 x 39.5 MH x $30/hr x 12	=	$156,420
Total removal and replacement cost			$325,800

Total annual F-4 maintenance cost for PPG-Liner Material		$743,555

10-Year Life Cycle Cost

Cost of replacement parts = $417,755 x 1.225 x 0.727[4] x 10	=	$3,720,420
Cost of removal and replacement = $325,800 x 1.225 x 10	=	$3,991,050
Total 10-year life cycle cost (PPG-Liner Material)	=	$7,711,470

(3) PPG-LM, service life factor of 2
(4) CRC - Crawford's Cost Reduction Curve

OPTION 2 (CANDIDATE 3 - IMPROVED CANOPY HINGE SUPPORT FITTINGS)

The results of the failure analysis indicate that a significant number of maintenance hours are being expended in the fitting and rigging of repaired canopies. Maintenance personnel at the ALC attribute this problem to the large tolerance variations that exist in the supporting cockpit structure, thus requiring a custom measuring and rigging process to properly align and adjust the canopy hinge fitting and locking mechanism. It was stated that the main cause is the limited amount of adjustment allowance that is available in the canopy to fuselage hinge support fitting. Figure 12 shows the existing arrangement, consisting of the hinge support fitting, serrated plate, and laminates of shim stock. In addition to the limited amount of adjustment, the trial and error process of determining the correct number of shims is also very time consuming (reference 8).

The removal and reinstallation of both the forward and aft canopies at the ALC requires 1-1/2 to 2 days. To ensure that alignment of the arches and attaching points can be maintained, a series of measurements is made, so that the same relationship is achieved after the repair of the canopy is accomplished. The repair and reinstallation of canopies at the operational base is difficult. In most cases the damaged canopy is sent to the ALC for repair.

The canopies sent to the ALC for repair, and fit-up of the replacement glass, arches, and frame assembly are measured to a standard set of dimensions. Consequently, the fitting and rigging of canopies returned to operational base that are measured to standard dimensions and sometimes installed on another aircraft entails a considerably longer time to reinstall. In some cases, the canopies cannot be satisfactorily fitted and must, again, be returned for rework. This situation can be very time consuming and costly.

It is recommended that the hinge support fittings for both the forward and aft canopies be redesigned to the configuration shown in figure 13 to provide easier adjustment and thereby substantially reduce the time required to fit and rig a repaired canopy.

Reference 8. T.O. 1F-4G-2-3, Technical Manual, "Maintenance Instructions, Seat and Canopy Systems USAF Series F-4G Aircraft," 15 April 1978

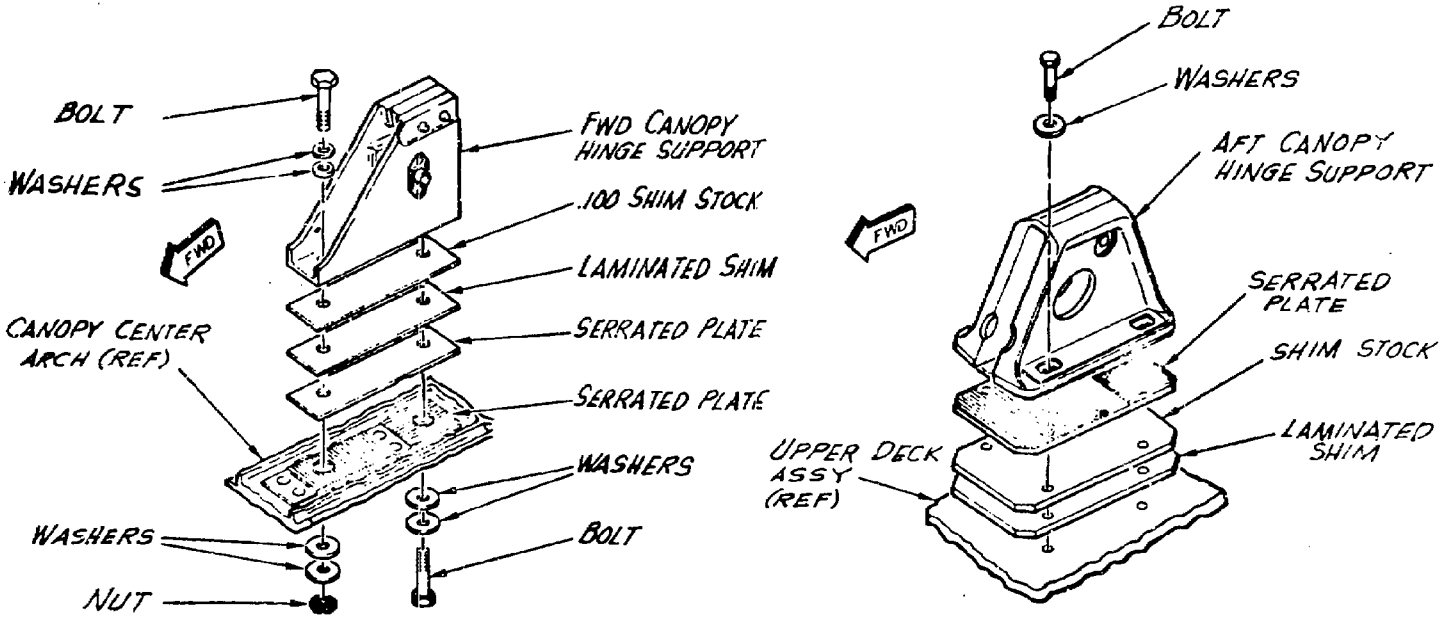

Figure 12. F-4 Existing Canopy Hinge Support Fittings

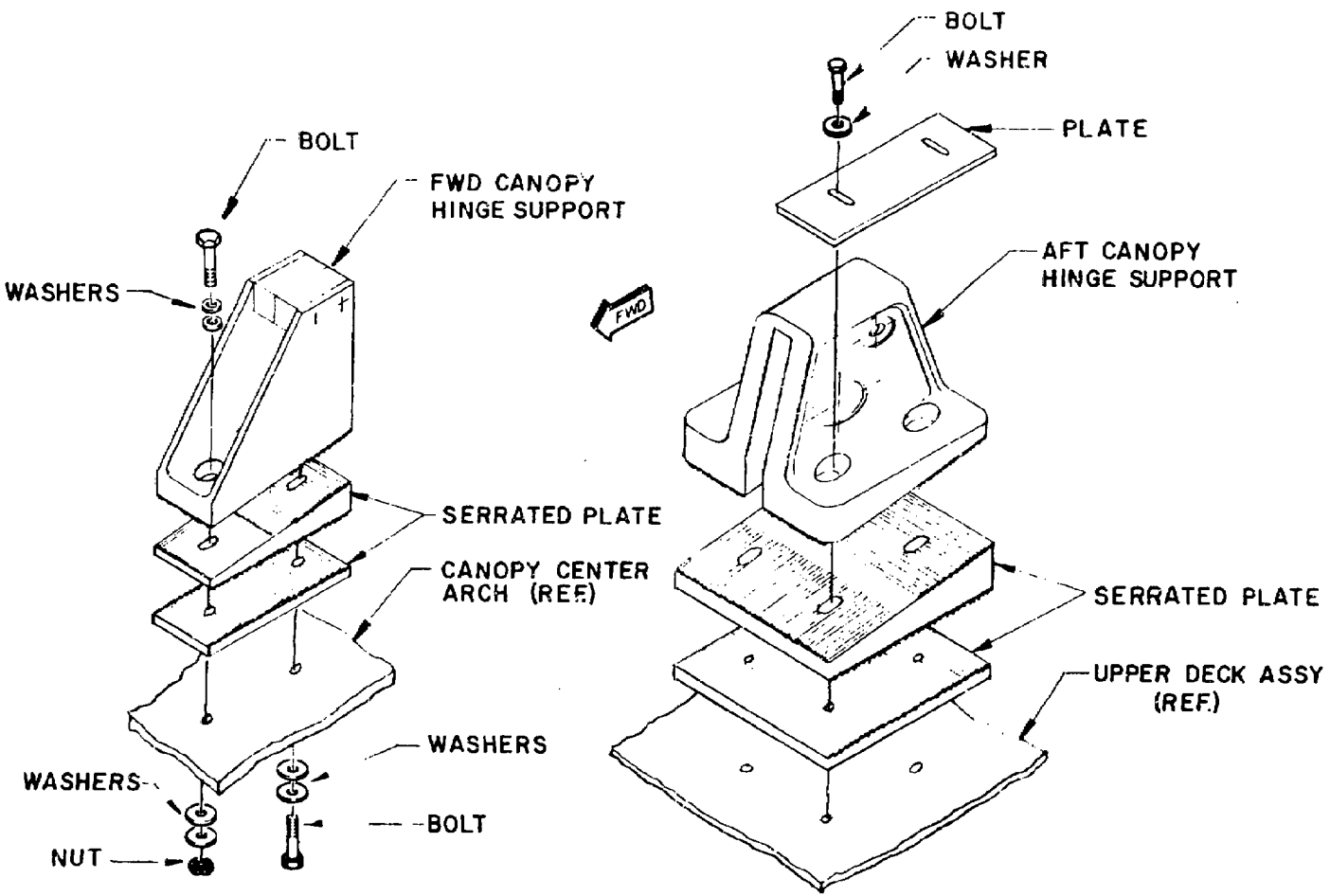

Figure 13. F-4 Proposed Canopy Hinge Support Fittings

The parts to be redesigned are:

Part No. 32-31817-303(LH), -304(RH) Fwd Canopy Support Ftg
Part No. 32G31819-1(LH), -2(RH) Aft Canopy Support Ftg

A review of the failure analysis indicates that to adjust the forward and aft canopy hinge support assembly to the required height is very time consuming. Attaching bolts have to be removed to add required shims for height adjustment on the old assemblies. To reduce the number of maintenance hours, the following changes are recommended: (1) The forward and aft canopy hinge support be redesigned to have a scope base with serrations to provide height adjustments with the mating bevel shim with serrations. (2) Make holes oversize on the support fittings for inboard, outboard, forward, and aft adjustments. (3) Slot holes on bevel shims, to adjust height by simply loosening attaching bolts and slipping bevel shim forward and aft.

Cost Analysis

The cost analysis for the proposed change is summarized in table 3. It presents the 10-year life cycle cost savings that can be achieved as a result of the reduced maintenance hours that will be realized through the incorporation of the improved canopy-to-fuselage fittings.

The savings in maintenance hours required for removal, fit-up, replacement, and rigging is estimated to be 21 percent. In terms of a 10-year life cycle cost, the estimated saving indicated in table 3 is $875,165. The offset to this saving is a $70,510 nonrecurring development and test cost. The additional offset is the replacement cost (recurring cost) $543,655 for the fabrication and supply of the redesigned fitting. The net 10-year life cycle cost savings is estimated to be $261,000, or an average annual saving of $26,100. Option 1 and Option 2 can be combined for a total annual savings of $721,700.

Table 4 presents a detailed cost analysis statement of the step-by-step assembly of the logic and the costing factors used to develop the cost trade. The basis for the unit costs and the replacement rates were data supplied by the Ogden Air Logistics Center. The data and factors used to determine the development and replacement costs were obtained from the Rockwell International pricing methods.

TABLE 3. COST ANALYSIS

F-4 TRANSPARENCY SYSTEM

OPTION 2 - IMPROVED CANOPY HINGE SUPPORT FITTINGS

Summary

Total 10-year life cycle cost of fitting and rigging (existing fittings)	$4,167,450
Redesign and development cost	$ 70,510
Replacement parts (for total fleet)	$ 543,655
Total 10-year life cycle cost of fitting and rigging (redesigned fittings) ($4,167,450 - $875,165)	$3,292,285
Net 10-year LCC cost saving	$ 261,000
Annual (average) saving	$ 26,100

TABLE 3. COST ANALYSIS (Continued)

F-4 TRANSPARENCY SYSTEM

OPTION 2 - IMPROVED CANOPY HINGE SUPPORT FITTINGS

Cost of R&R Fitting and Rigging

Replacement Rate

WUC 1232A, fwd canopy	23 per mo
WUC 1235A, aft canopy	22 per mo

Removal and Replacement Cost

Fwd canopy 23 x 21.0 MH x $30/hr x 12	$173,880
Aft canopy 22 x 21.0 MH x $30/hr x 12	$166,320
Total annual F-4 maintenance cost for canopies[5]	$340,200

10-Year Life Cycle Cost

Cost of R&R fitting and rigging $340,200 x 1.225[6] x 10 =		$4,167,450
Estimated reduction in fitting and rigging hours (see page 41)		21%
Savings in man-hours expended in R&R Using redesigned fitting = 0.21 x 4,167,450	=	$875,165
Redesign and development cost (see page 40)	=	$ 70,510
Replacement parts (see page 40)	=	$543,655
Net 10-year life cycle cost saving	=	$261,000
Annual (average) savings	=	$ 26,100

(5) ALC data (reference 7)
(6) Escalation factor (reference 6)

TABLE 3. COST ANALYSIS (Concluded)

F-4 TRANSPARENCY SYSTEM

OPTION 2 - IMPROVED CANOPY HINGE SUPPORT FITTINGS

Redesign and Development Cost

Nonrecurring

Total development - 2 configurations at		$17,200
Fab 4 units at 22.5 hr x $40/hr =		$ 900
Tooling	297.2 hr x $40/hr =	$11,888
Material	=	$ 112
Engineering	350 hr at $40/hr =	$14,000
T.O.'s	250 hr at $40/hr =	10,000
Test	2 units at $5,000 each	10,000
		$64,100
Unknown 10% of $64,101		6,410
Total nonrecurring		$70,510

Recurring Cost

Replacement parts

Shipset (S/S) fwd canopy hinges =		2,800	(total No. aircraft
Pcs per shipset		2	in fleet)
		5,600	
Avg cost/fwd hinge		$33.61	
		$188,216	$188,216
Shipset (S/S) aft canopy hinge =		2,800	
Pcs per shipset		2	
		5,600	
Avg cost/aft hinge		$45.64	
		$255,584	$255,584
			$443,800
Escalation factor 1978-1983			1.225
Total recurring cost			$543,655

TABLE 4. COST ANALYSIS

F-4 TRANSPARENCY SYSTEM

OPTION 2 - IMPROVED CANOPY HINGE SUPPORT FITTINGS

ESTIMATED HOURS TO REMOVE AND REPLACE

The procedures required to remove and replace the canopy assemblies as specified in T.O. 1F-4G-2-3 (reference 8) maintenance instructions for the F-4C seat and canopy system. The following is an estimate of the maintenance hours required for each step and each operation. This estimate was developed by a Rockwell field engineer experienced in the R&R of fighter-type transparency systems. It should be noted that the important factors developed in this estimate is the percentage to maintenance hours saved. Since the resultant absolute hours developed correlate with R&R hours obtained from the field audit of the ALC, the percent saving is considered to be valid.

Step	Maintenance Hours Req'd Each	Saved Each
Removed Canopy	1.5	
Install New/Repaired Canopy		
1. Prepare for Initial Fit - Remove hold bolts, rain seal, stop bolts, loosen index plates, adjust bellows, readjust hinge support fitting, install temperature shim, and adjust forward stop bolts	2.0	-1.0
2. Lift Canopy in Place - Engage hinge arms, temporarily install raw stock, open and install canopy brace, extend actuator, close canopy, take measurements, add shims as required to obtain dimension at forward hooks, open canopy, and disconnect actuator	2.5	-1.0
3. Close Canopy - Add shot bag, check forward butt gap, raise canopy, loosen canopy hinge supports, adjust forward to get butt gap, close canopy, remove shot bags, and recheck butt gap	1.5	-0.5
4. Check Aft Butt Gap - Mark for trimming, raise and remove canopy, trim aft edge of canopy, reinstall and lower canopy, add shot bags, and check butt gap (repeat as required)	1.5	
5. Adjust Hooks and Locking Mechanism	2.0	

TABLE 4. COST ANALYSIS (Concluded)

F-4 TRANSPARENCY SYSTEM

OPTION 2 - IMPROVED CANOPY HINGE SUPPORT FITTINGS

Step	Maintenance Hours Req'd Each	Maintenance Hours Saved Each
6. Adjust Canopy Centerline - Scribe canopy hinge support, loosen canopy hinge support bolts, align canopy centerline, check lateral adjustment, adjust forward hooks	1.5	-0.5
7. Match Check Forward and Aft Location - Scribe shim stack at hinge supports, raise and support canopy, adjust canopy mismatch (by adjustment in number of laminations in temperature shim), pull down and close canopy, and recheck	2.0	-1.0
8. Trim Fairings - Remove canopy and trim as marked, reinstall canopy and add shot bags, check clearance, adjust fairing, shim for correct alignment, recheck butt gap with canopy closed (retrim as required)	2.0	
9. Adjust Canopy Stop Bolts	0.5	
10. Check Canopy Alignment - Close canopy, add shot bags, check alignment (by tape check), correct misalignment as required	1.5	-0.5
11. Final Installation and Checkout - Torque and safety-lock hinge bolts and hinge support bolts, adjust canopy seal bellows, adjust actuator, rig lock mechanism, install rain seal, install rear view mirrors, install canopy, actuate and inspect	2.0	
12. Miscellaneous Handling	0.5	
Total hours for R&R (each canopy)	21.0	4.5

Percent fitting and rigging savings = 4.5/21 = 0.21 (21 percent)

SECTION IV

A-7D TRANSPARENCY SYSTEM DESIGN IMPROVEMENT TRADE STUDY

CONFIGURATION DESCRIPTION

The A-7D transparency configuration consists of a three-piece windshield assembly and a single-piece canopy as depicted in figure 14. The windshield center panel (figure 15) is a flat, five-ply, glass-laminate arrangement. The panel is preloaded as a column when installed in a machined frame and is retained with sheet metal angles. The windshield side panels are a single curvature monolithic stretched acrylic with nylon acrylic edge members.

The canopy (figure 16) is a compound curved monolithic stretched acrylic panel. The perimeter of the panel is edged with nylon acrylic. A diaphram-type seal is installed around the canopy frame for pressure sealing.

The associated support systems include defogging, rain removal, cockpit pressurization, and a mechanical canopy release system.

FAILURE ANALYSIS

An assessment of the A-7D transparency system failures as extracted from the maintenance analysis (MAM's) program plus the failures obtained from field audit were compiled in the form of a fault tree as shown in figure 17. The conclusions reached after study and rationalization of the How-Mals and field experiences were then assembled and summarized in figure 18. The major problems that surfaced from these data were:

1. Excessive scratching and abrasion of the S/A transparent panels

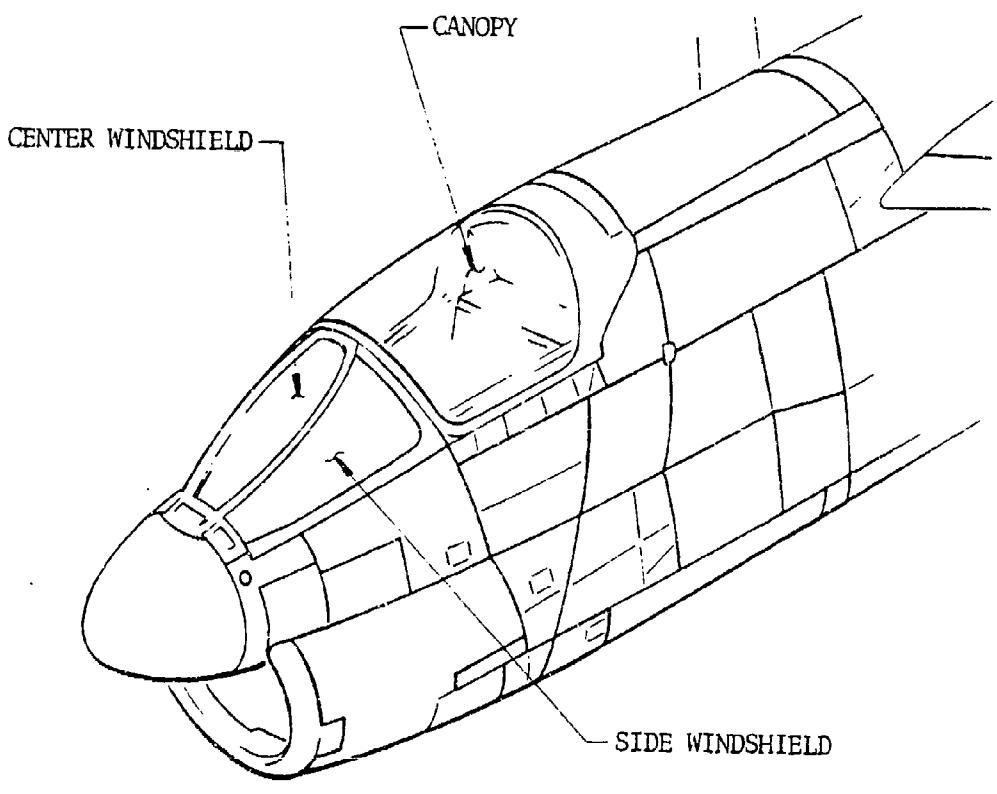

Figure 14. A-7D Transparency Configuration

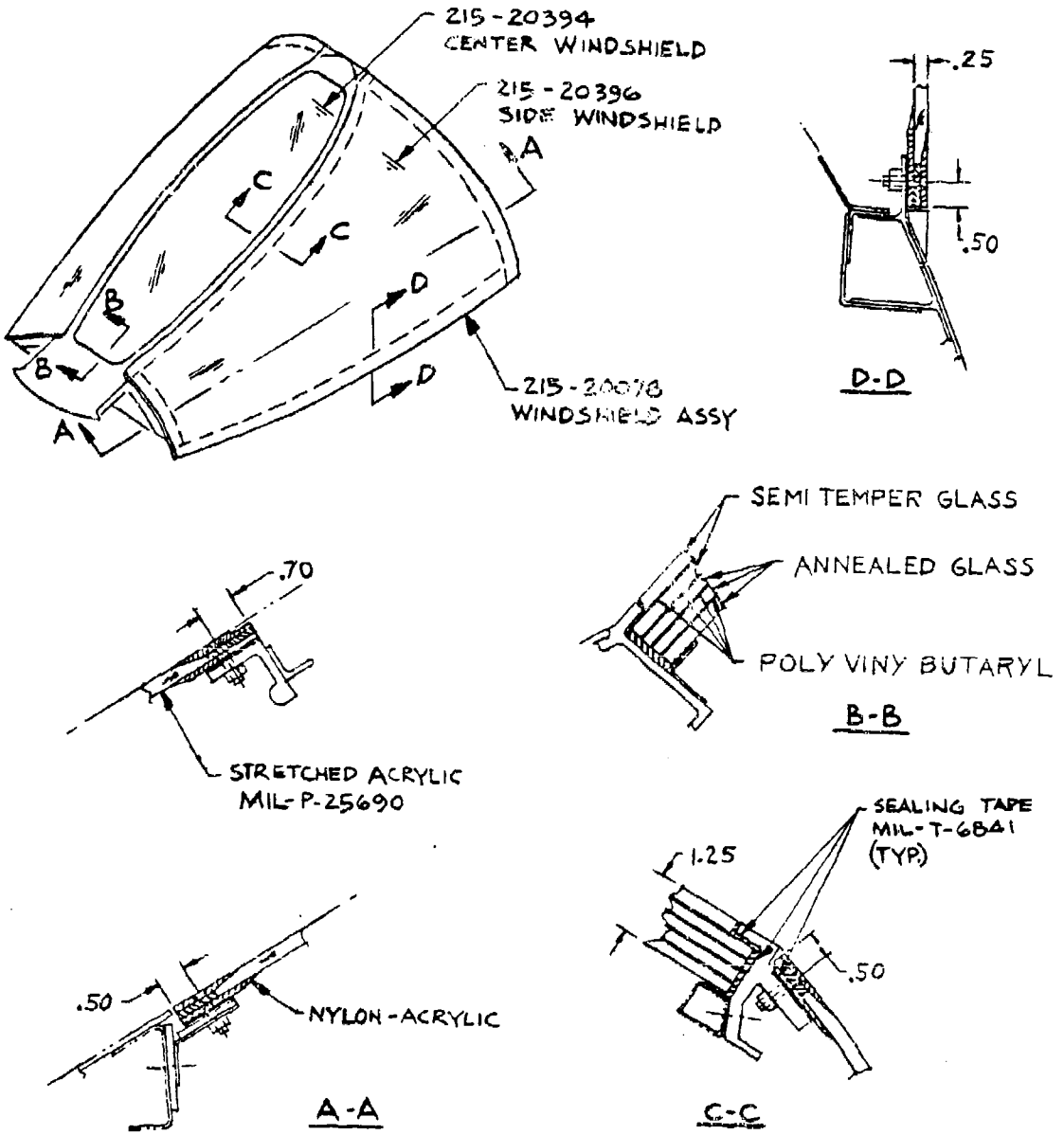

Figure 15. A-7D Windshield Assembly

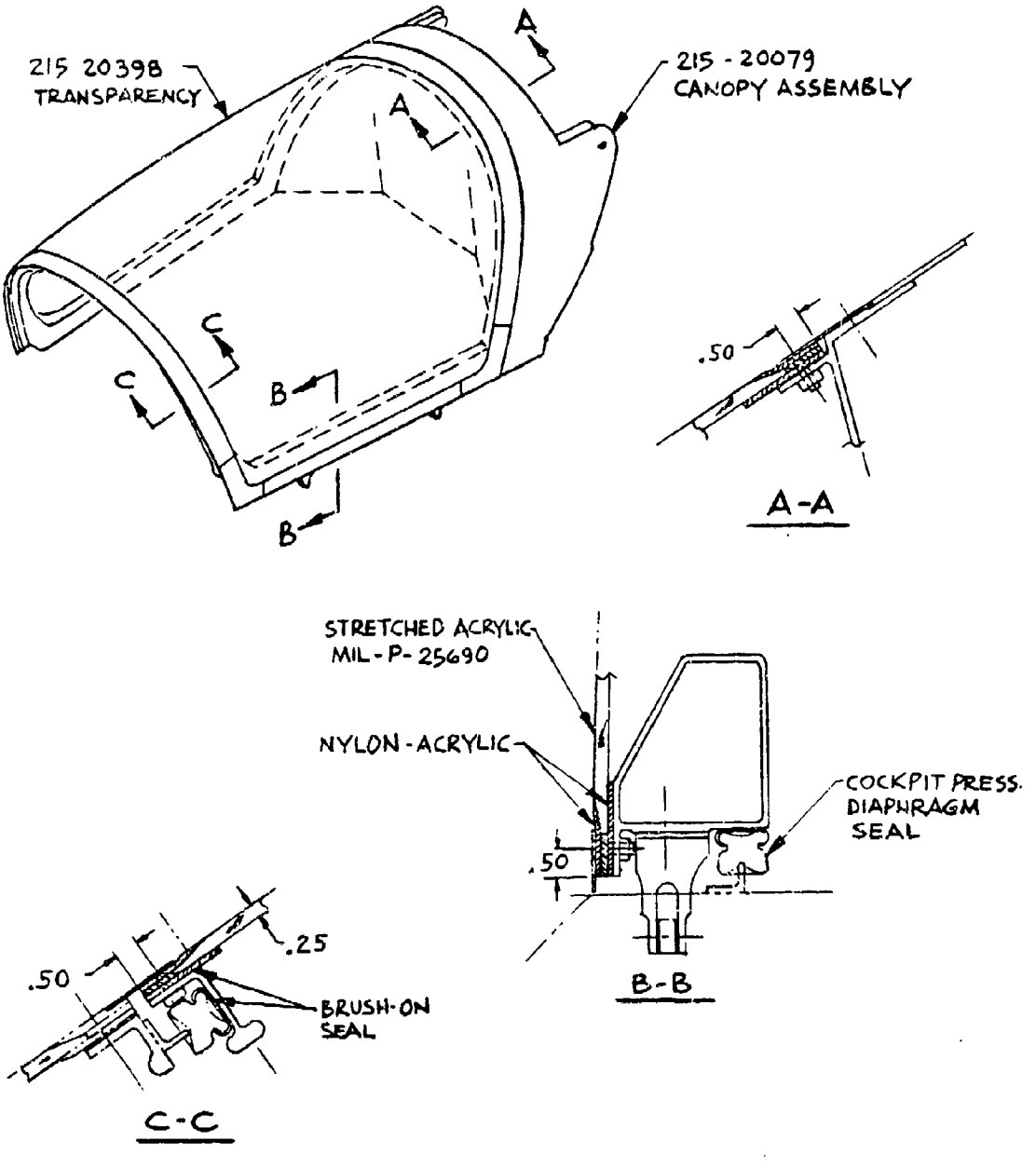

Figure 16. A-7D Canopy Assembly

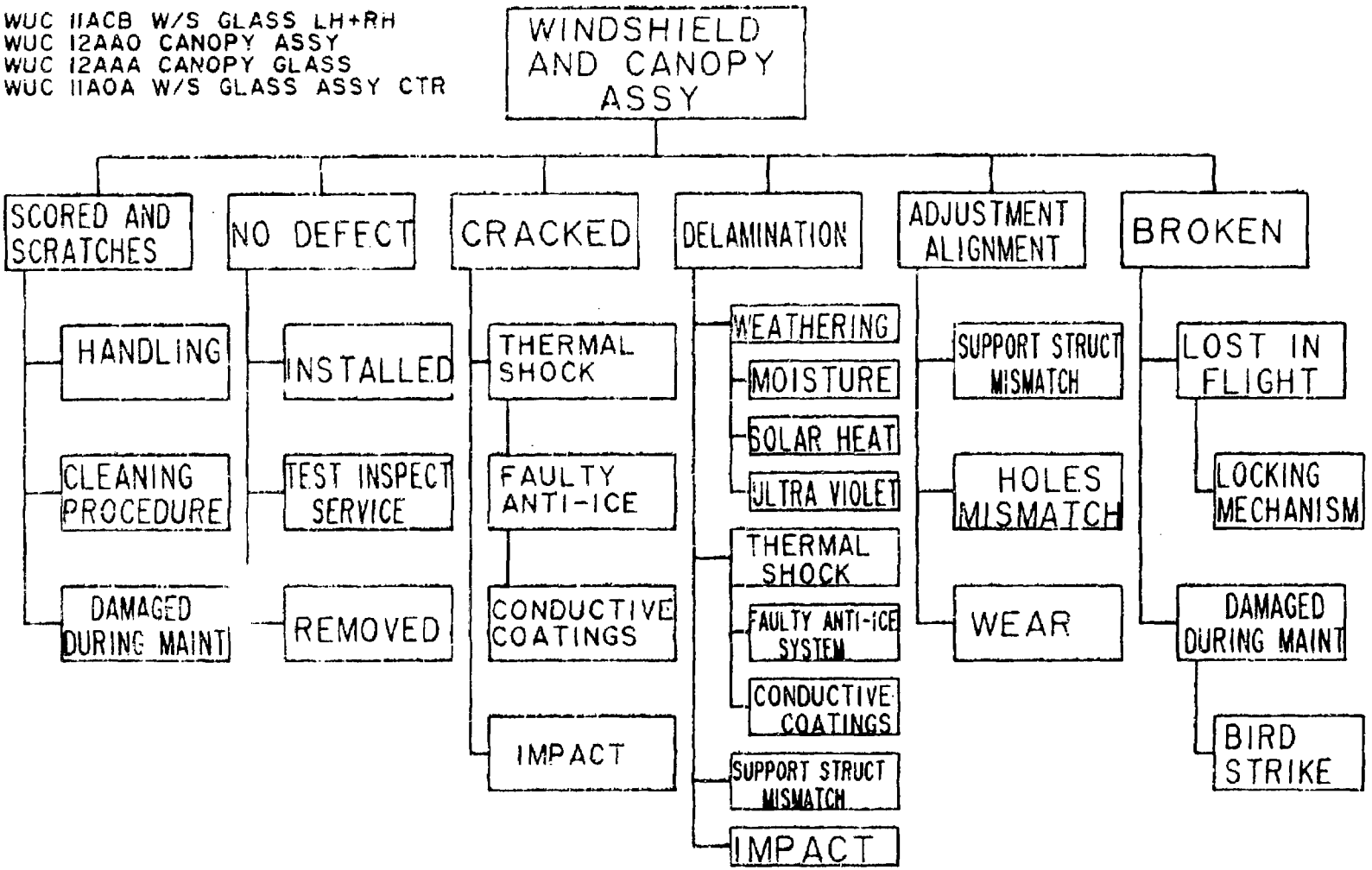

Figure 17. Fault Tree A-7D Windshield and Canopy Assemblies

WUC 11ACB WINDSHIELD GLASS ASSEMBLY, LH AND RH
12AAO CANOPY ASSEMBLY
12AAA CANOPY GLASS CENTER
11AOA WINDSHIELD GLASS ASSEMBLY CENTER

HOW-MAL		ACTION TAKEN	PROBABLE CAUSE
935	SCORES AND SCRATCHES	R - REMOVED AND REPLACED A - BENCH CHECKED AND REPAIRED P - REMOVED G - REPAIRED/REPLACED MINOR PARTS	• SANDBLAST • DAMAGED DURING MAINTENANCE
799	NO DEFECTS	Q - INSTALLED X - TESTED-INSPECTED-SERVICED P - REMOVED	• INTERRELATED WITH OTHER HOW-MAL CODE
190	CRACKED	R - REMOVED AND REPLACED A - BENCH CHECKED AND REPAIRED P - REMOVED	• THERMAL SHOCK • IMPACT
127	ADJUSTMENT AND ALIGNMENT	L - ADJUSTED A - BENCH CHECKED AND REPAIRED G - REPAIRED/REPLACED MINOR PARTS	• NOT ENOUGH ADJUSTMENT
846	DELAMINATION	R - REMOVED AND REPLACED G - REPAIRED/REPLACED MINOR PARTS	• WEATHER (MOISTURE) • INSUFFICIENT SEALANT • THERMAL SHOCK

Figure 18. A-7D Windshield and Canopy Failure Analysis Summary

2. Delamination and cracking of the laminated glass panel

3. Canopy transparent panel edge-member alignment and attachment problems

4. Canopy latching and ejection mechanism rigging and interfacing problem

The potential candidate design improvements that were immediately considered as possible solutions to these problems were:

1. Incorporation of a protective coating to reduce scratching and abrasion

2. Incorporation of a laminated configuration to include a hardened outer ply for improved resistance to scratching and abrasion

3. Incorporation of an improved canopy edge member to reduce fastener attachment and alignment problems

4. Improvement of the canopy mechanical linkage of the latching and ejection mechanism to preclude inadvertent ejection

5. Improved edge sealing of the center glass panel

In an attempt to obtain an update of the A-7D maintenance problems and activity, a call was placed to the system manager at the Oklahoma City Air Logistics Center. Rockwell International was advised that as a result of the loss of three A-7D aircraft, an engineering change proposal (ECP 562) entitled, "Canopy Retention System, Improvement of," was initiated by the Oklahoma City ALC on or about 28 December 1978. The failure of the canopy has been attributed to:

1. Inadvertent ejection caused by improper disengagement of canopy retention system

2. Inadvertent ejection due to canopy loss resulting from debonding of the transparent panel fiber-glass edge-attachment members

Since the ECP, being implemented by LTV, includes the redesign and rework of tasks/items similar to those that Rockwell International had planned to conduct, it was concluded that duplication of these design improvements would not be cost effective. In view of this development, Rockwell International elected to terminate any further effort relating to the A-7D transparency system.

The failure mode descriptors in combination with flight hours, maintenance hours, and logistical cost are contained in the sampling MAM's tabulation shown in Figure A-2 of Appendix A.

SECTION V

C-130 TRANSPARENCY SYSTEM DESIGN IMPROVEMENT TRADE STUDY

CONFIGURATION DESCRIPTION

The C-130 transparency system for the crew compartment includes 23 windshield and viewing window panels as depicted in figure 19. The total number of panels considered in this study were narrowed down to nine windshields and four windows based on the rankings as contained in the MAM's (refer to Appendix A-3) and as selected from field audits. The typical windshield configuration, as shown in figure 20, is a two-ply glass panel with an extended edge polyvinyl butyral interlayer. The outer glass ply incorporates the conductive coating for anti-icing provisions. Edge member faying surface sealant and aerodynamic seal provide the moisture barrier.

FAILURE ANALYSIS

The results of the C-130 failure analysis developed from AFM 66-1 MDC data and compiled in the MAM's program indicates that approximately 50 percent of the cost of maintaining the selected windshields and windows results from delaminations, cracking, and arcing. The failures for these components are block diagramed in the windshield and window fault tree, figure 21. In addition, the principal modes of failure (How-Mal) and the actions taken to repair and/or fix the failures are correspondingly listed. These factors along with the probable cause of failure are summarized in figure 22.

Although the MAM's printouts as contained in Appendix A-3 provided the primary data base, a great deal of reliance was placed on the data collected from the field level and from the ALC's. The failure mode descriptors in combination with flight hours, maintenance hours, and logistical cost are contained in the sampling MAM's tabulation shown in figure A-3 of Appendix A.

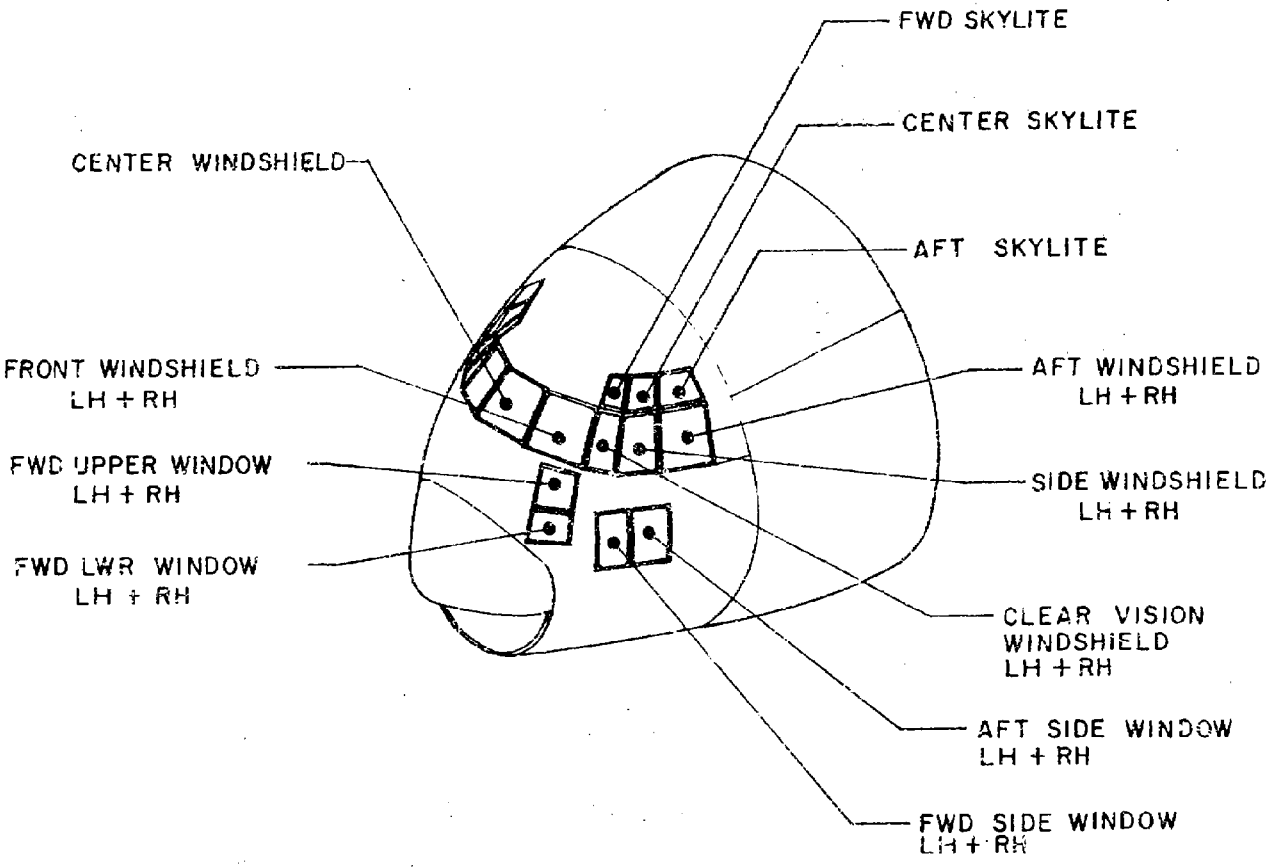

Figure 19. C-130 Crew Compartment Transparency Configuration

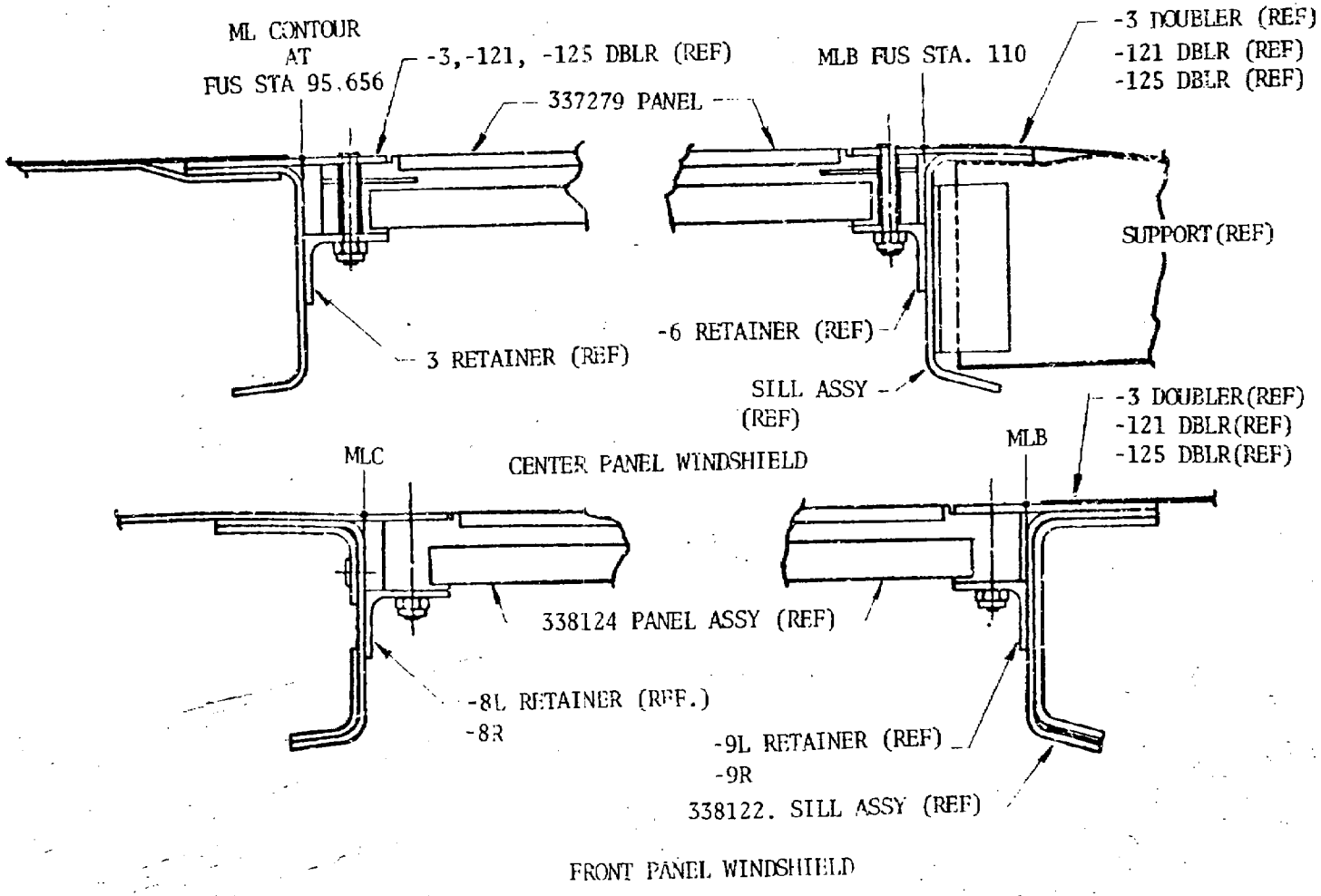

Figure 20. C-130 Existing Windshield Typical Edge Configuration

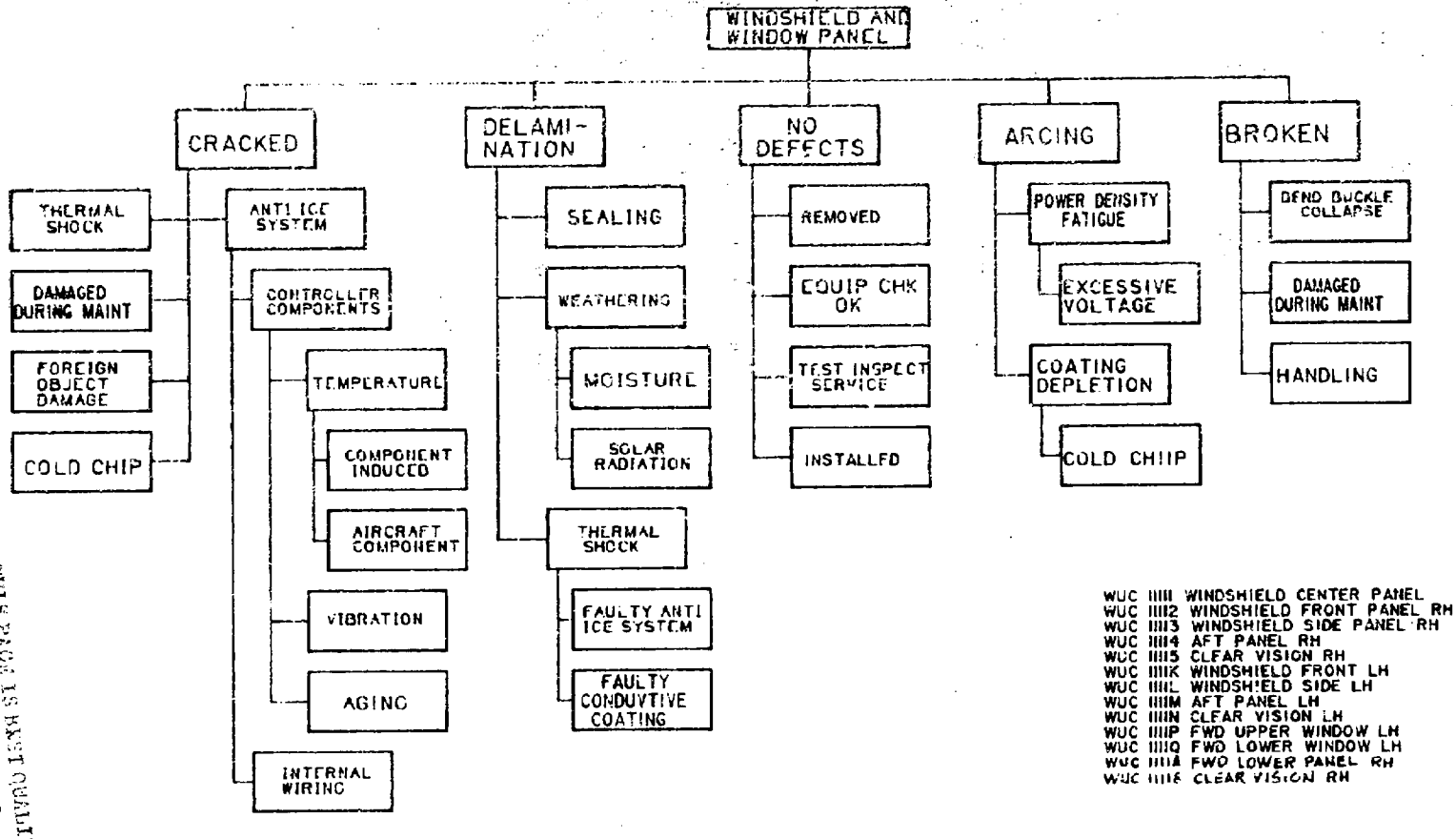

Figure 21. Fault Tree C-130 Windshield and Window Installation

WUC 11111	WINDSHIELD CENTER PANEL	WUC 1111A	Forward Lower Panel RH
WUC 11112	WINDSHIELD FRONT PANEL R.H.	WUC 1111K	FRONT WINDSHIELD L.H.
WUC 11113	WINDSHIELD SIDE PANEL R.H.	WUC 1111L	SIDE WINDSHIELD L.H.
WUC 11114	AFT PANEL R.H.	WUC 1111M	AFT PANEL L.H.
WUC 11115	CLEAR VISION R.H.	WUC 1111N	CLEAR VISION L.H.
WUC 11118	CLEAR VISION R.H.	WUC 1111P	FORWARD UPPER WINDOW L.H.
		WUC 1111Q	FORWARD LOWER WINDOW L.H.

HOW MAL	ACTION TAKEN	PROBABLE CAUSE
190 CRACKED	R - REMOVED AND REPLACED P - REMOVED Q - INSTALLED G - RPR/RPLT MINOR PARTS	° ANTI-ICE SYSTEM ° THERMAL SHOCK ° DAMAGED DURING MAINTENANCE ° FOREIGN OBJECT DAMAGE COLD CHIP
846 DELAMINATION	R - REMOVE AND REPLACE P - REMOVED Q - INSTALLED	° SEALING ° WEATHERING ° THERMAL SHOCK
799 NO DEFECTS	Q - INSTALLED H - EQUIPMENT O.K., NO REPAIR REQUIRED	° INTERRELATED WITH OTHER CODES
007 ARCING, ARCED	P - REMOVED R - REMOVED AND REPLACED P - REMOVED Q - INSTALLED	 ° POWER DENSITY FATIGUE ° COATING DEPLETION
070 BROKEN	R - REMOVE AND REPLACE P - REMOVED G - RPR/RPLT MINOR PARTS	° DAMAGED

Figure 22. C-130 Windshield and Window Assembly Failure Analysis Summary

CANDIDATE DESIGN IMPROVEMENTS

It was concluded from review of the failure analysis data and the problems related by the field personnel maintaining the C-130 transparencies that the following candidate improvements should be considered and investigated.

1. Redesign windshield to incorporate a dry seal and improved edge seal.

2. Include edge heater for anti-iced windshields.

3. Incorporate solid-state anti-icing controllers.

INVESTIGATION AND RATIONALE FOR SELECTED CANDIDATES

CANDIDATE 1 - IMPROVED WINDSHIELD EDGE SEALING

Cracking and delaminations account for a major portion of the failures reported for typical windshields shown in figure 20 The delaminations were largely attributed to moisture penetration at the panel frame and edge member. It is therefore proposed that a dry seal and zee frame be used to reduce this type failure. (See figure 23.)

CANDIDATE 2 - WINDSHIELD EDGE HEATER

The maintenance people that are experienced with C-130 windshields state that cracking is largely due to thermal shock, service aging, and installation procedures. Further study of these factors indicates that under certain conditions, the temperature differential between the center of the panel and the edge causes a thermal variation that is the probable cause of a portion of the cracking problem. It is therefore recommended that an edge heater be incorporated to reduce this type of failure. (See figure 24.) The additional benefit of this change is the added protection against delamination.

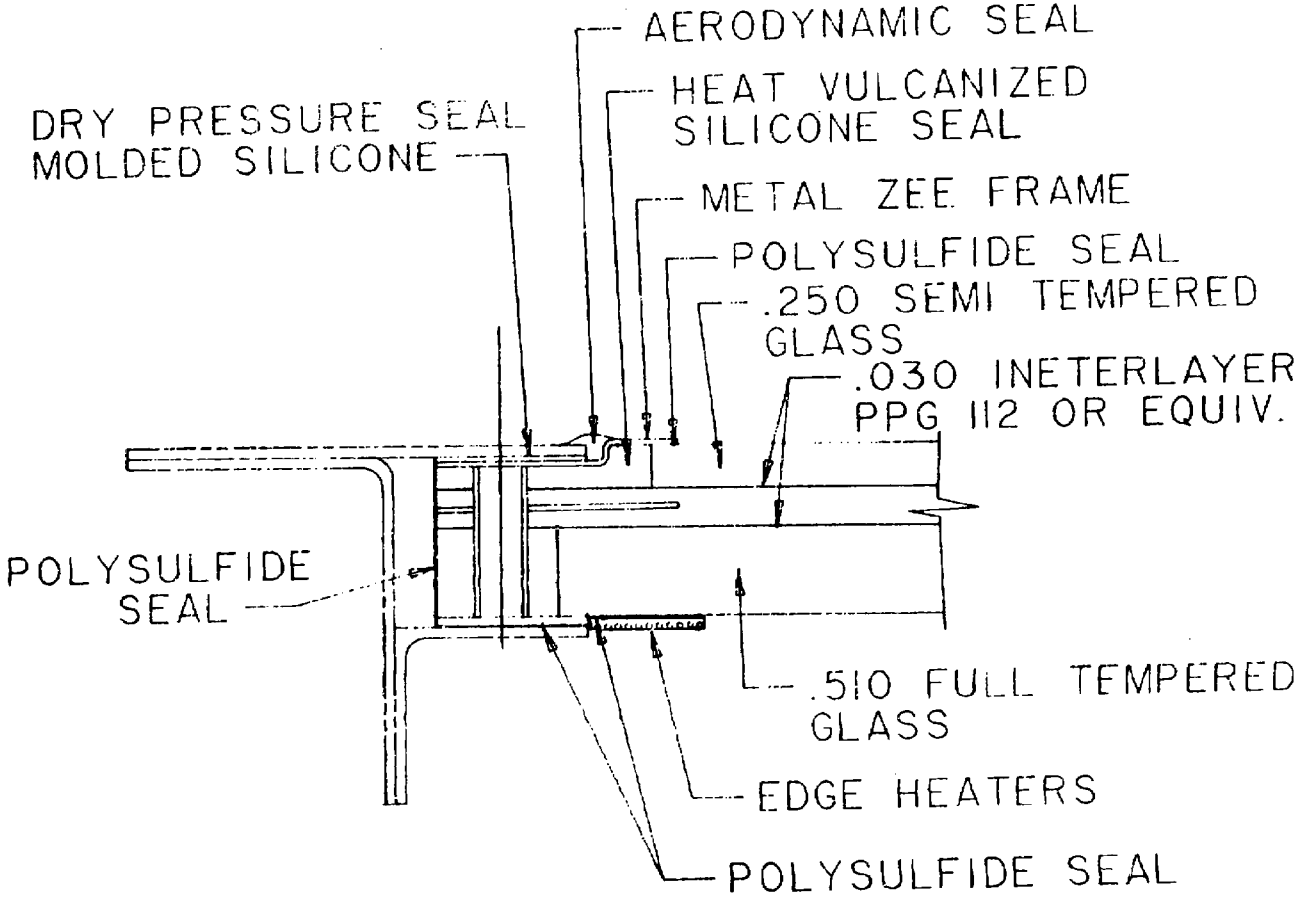

Figure 23. C-130 Proposed Windshield Typical Configuraton

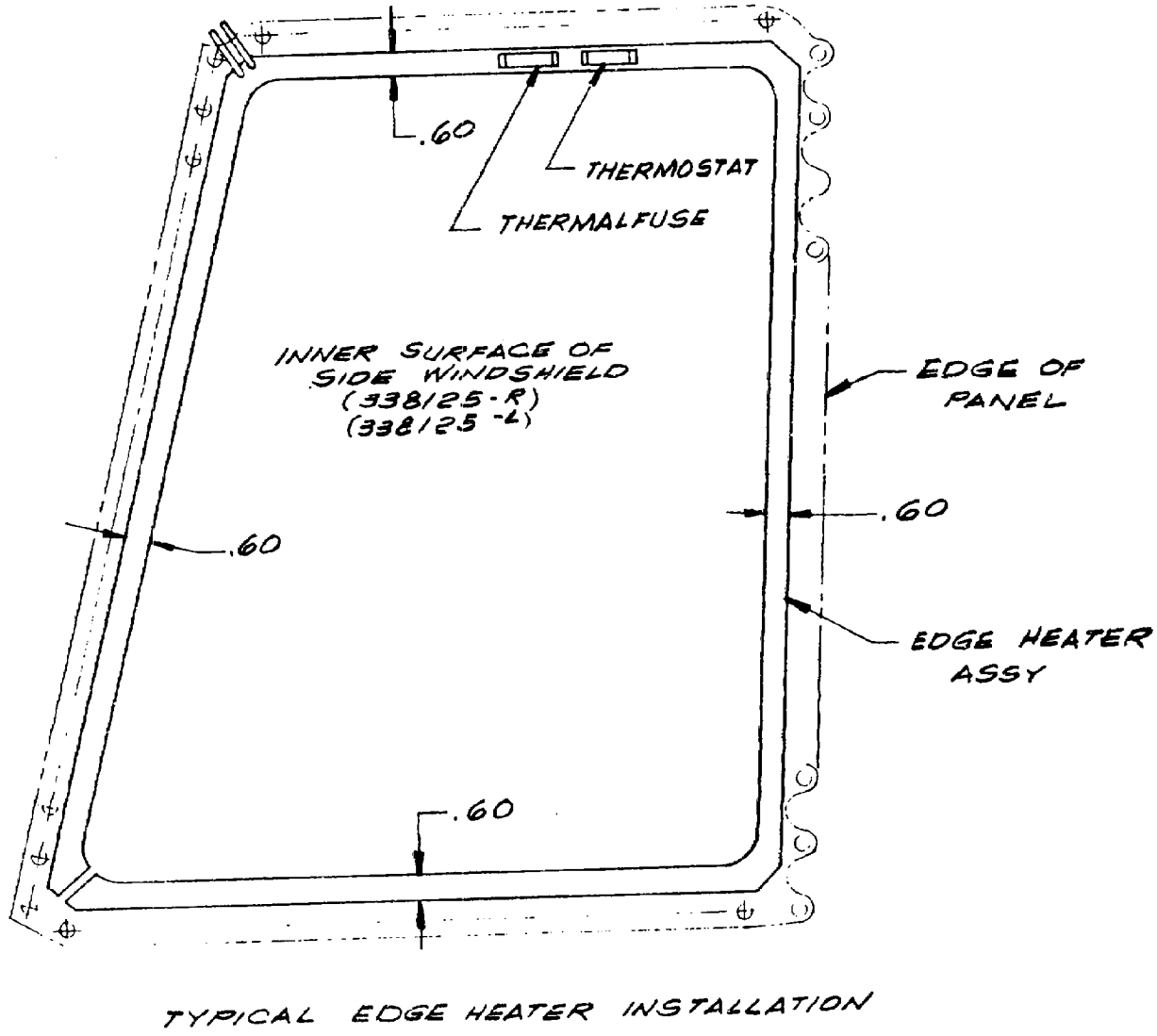

Figure 24. C-130 Windshield Panel Edge Heater Installation

CANDIDATE 3 - SOLID-STATE ANTI-ICING CONTROLLERS

Another item affecting the failure of heated windshields is the temperature controllers. Due to the complexity of the controller, the mechanism often fails to operate properly. Although the reported failures of the C-130 controllers are smaller than those of other cargo-type anti-icing systems, it is believed that as the fleet ages, failures of these components will significantly increase resulting in greater replacement rates. This problem can be greatly reduced by the incorporation of a modern solid-state controller with order of magnitude in improvement in reliability.

CANDIDATE 4 - IMPROVED SEALING OF SIDE WINDOW LOWER ATTACHMENT

The forward side windows as depicted in figure 19 and in figure 25 are subject to collection of moisture puddling between the side longeron and the floor assembly. The moisture collecting in this area causes the delamination of the side window panels. It is therefore proposed that fillet and faying surface seals as shown in figure 25 be incorporated to reduce the source of delamination. This proposed change should be considered as quickly as practical. Sufficient detailed maintenance and costing data were not available at this time.

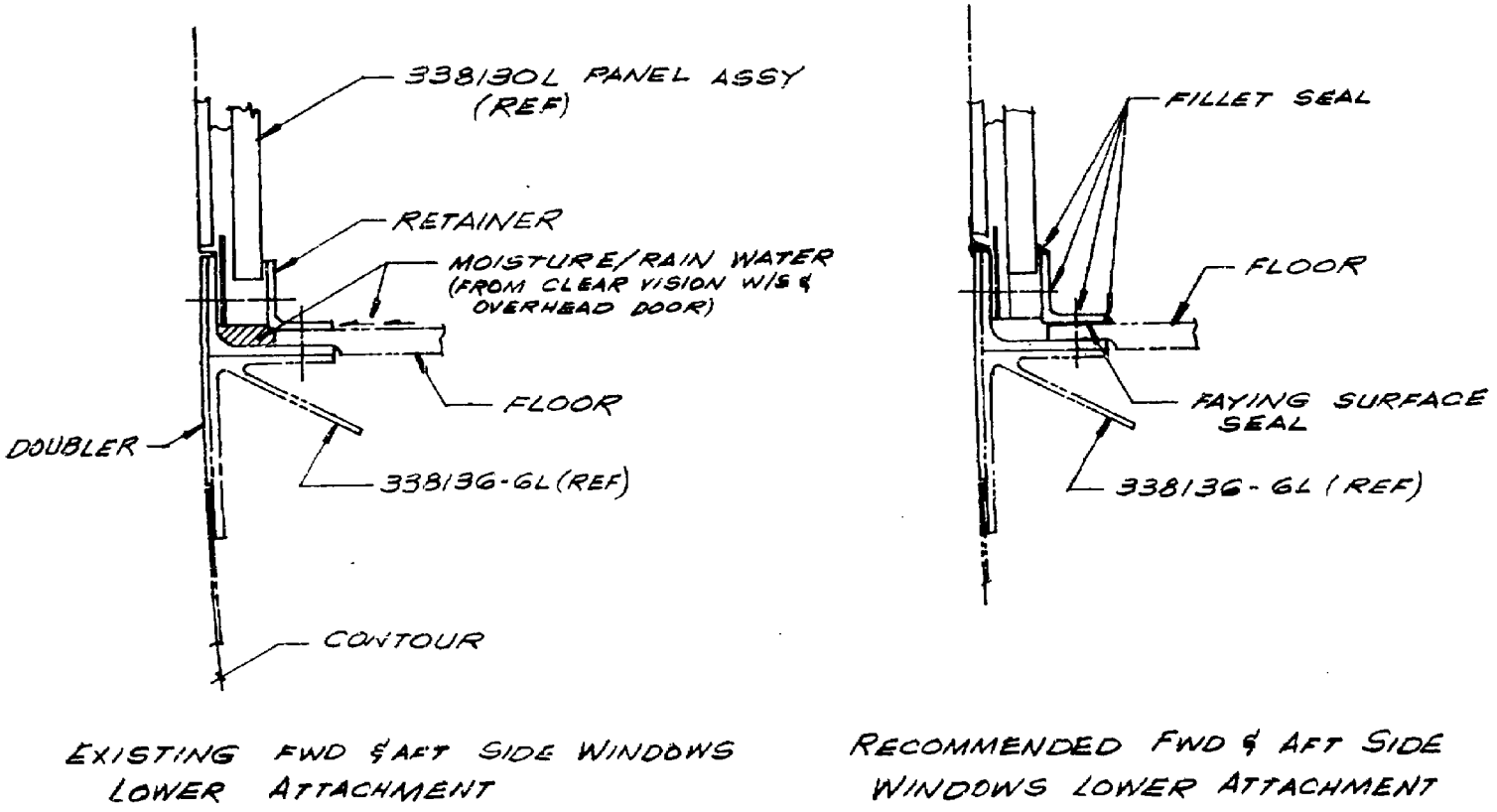

Figure 25. C-130 Side Windows Lower Attachment

SELECTED TRADE STUDIES

Analysis of the failure modes and based on the cost trade results, it was concluded that candidates number one (improved edge sealing) and number two (incorporation of edge heaters) should be implemented as soon as practical. It was further concluded that the initiation of a modern solid-state controller be considered in the not too distant future.

PROPOSED CHANGE OPTIONS

OPTION 1 (CANDIDATE 1 - IMPROVED WINDSHIELD EDGE SEALING)

The proposed change for reducing this high-cost maintenance problem is to incorporate a zee strip edge frame, revise the edge sealing arrangement, and incorporate an improved flexible interlayer as shown in figure 23.

A heat-vulcanized silicone seal, covering the entire edge of the glass panel, provides a moisture barrier to prevent penetration of the laminates. The edge facing of the glass panel includes a rubber gasket peripheral seal at the inner side, and dry pressure seal (molded silicone) is affixed to the outer side. The use of the formed-in-place fairing compound greatly reduces the installation time. Closure of the gap between the glass panel and the windshield support frame is accomplished with a metallic zee frame and aero-smoother sealant as depicted in figure 23.

In order to further reduce delamination and cold chipping that results from moisture penetration, it is recommended that an 0.030 laminate of PPG 112, or equivalent, interlayer replace a like amount of polyvinyl butyral adjacent to each glass laminate (see figure 23).

The windshields and compartment windows considered in this option are:

WUC	Description	National Stock Number
1111A	Fwd Lwr, Pnl, RH	1560-00-098-7911
1111K	Frt Pnl, LH	1560-00-962-3511
1111L	Side Pnl, LH	1560-00-962-3513
1111M	Aft Pnl, LH	1560-00-307-1727
1111N	Clr Vis, Pnl, LH	1560-00-098-7914
1111P	Fwd Upr, Pnl, LH	1560-00-962-3515
1111Q	Fwd Lwr, Pnl, RH	1560-00-966-3515
11111	Ctr Pnl	1560-00-035-2136
11112	Frt Pnl, RH	1560-00-307-1724
11113	Side Pnl, RH	1560-00-962-3514
11114	Aft Pnl, RH	1560-00-307-1728
11115	Clr Vis, Pnl, RH	1560-00-098-7915
11118	Fwd Upr, Pnl, RH	1560-00-035-2153

Cost Analysis

The annual saving in the cost of incorporating this revised windshield concept is estimated to be $136,800. This is based on a cost trade analysis (refer to table 5) developed for a 10-year life cycle costing. The source of maintenance hours, number of spares, unit cost was data provided by Warner Robins ALC, reference 9. Option 1 and Option 2 can be combined for a total annual savings of $174,400.

An additional source for the cost analysis supporting this study was the data collected from the field audits of the original study plus data obtained from the operational Air Force bases listed in Section II. The combination of these data was correlated with the AFM 66-1 MDC data used as the data base for all these studies.

Reference 9. G. C. Boettcher, Col, USAF, "Aircraft Transparency Failure and Logistical Cost Analysis, C-130, 79LA-0226", AFLC Letter WR/ALC/MMSF, Headquarters Warner Robins Air Logistics Center (AFLC), Robins Air Force Base, Georgia 31098, 21 March 1979.

TABLE 5. COST ANALYSIS

C-130 TRANSPARENCY SYSTEM

OPTION 1 - IMPROVED WINDSHIELD EDGE SEALING

Summary

Normal Attrition Refurbishment

Present Concept	
Field maintenance	$2,170,984
Spares	5,793,068
Total F/M and spares 10-year LCC	$7,964,052
Redesign Concept	
Redesign and development	$ 573,657
Field maintenance	1,113,262
Spares	4,909,059
Total F/M and spares nonrecurring and recurring 10-year LCC	$6,595,978
Net 10-year LCC cost saving	$1,368,074
Annual (average) savings	$ 136,800

TABLE 5. COST ANALYSIS (Continued)

C-130 TRANSPARENCY SYSTEM

OPTION 1 - IMPROVED WINDSHIELD EDGE SEALING

Present Concept

Field maintenance	
Windshields and windows	
WUC total (see page 69)	$ 152,994
Total years	10
Escalation 1976-1983	1.419(7)
Total cost 10 years	$2,170,984
Spares	
Windshields	
WUC total (see page 70)	$ 408,250
Total years	10
Escalation factor 1976-1983	1.419
Total cost 10 years	$5,793,068
Total field maintenance and spares	$7,964,052

(7) Escalation factors (reference 6)

TABLE 5. COST ANALYIS (Continued)

C-130 TRANSPARENCY SYSTEM

OPTION 1 - IMPROVED WINDSHIELD EDGE SEALING

Redesign Concept			
Nonrecurring cost			
Tooling (for average configuration)			
(2) Strip PFP production flat pattern		10 hours	
HDP hydropress die		150 hours	
HTF heat-treat fixture		60 hours	
Molded silicone seal			
Mold		40 hours	
SRD steel rule die		30 hours	
Total labor hours		290 hours	
Tooling labor rate		$40/hour	
Tooling labor dollars			$ 11,600
Tooling material at $6.00/hr (incl DH)			1,740
Total tooling (for average configurations)			$ 13,340
Total configurations			7
Total tooling			$ 93,380
Engineering			
Design		1,960 hours	
TCTO		396 hours	
Total engineering labor		2,356 hours	
Engineering labor rate		$40/hour	
Engineering labor dollars			$ 94,240
Engineering material			127
Total engineering			$94,367
Certification			
Engineering		$ 4,000	
Testing		40,000	
Panel fabrication (10 each)		11,130	
Current panel cost	$ 539		
Frame at 4 x boom frame	340		
New (46% current 539)	234		
	$1,113		
Total certification/panel		$55,130	
Total certification 7 panels x $55,130			$385,910
Total nonrecurring cost			$573,657

TABLE 5. COST ANALYSIS (Continued)

C-130 TRANSPARENCY SYSTEM

OPTION 1 - IMPROVED WINDSHIELD EDGE SEALING

Redesign Concept

Recurring cost

Field maintenance windshields		
Total WUC attributed to other than DDCC[8] (ref pg 69)		$ 24,906
Total WUC attributed to DDCC (ref pg 69)	$152,994	
Service life improvement ($152,994 x 0.65)[9]	99,446	
Reduced field maintenance attributed to DDCC		$ 53,548
Annual field maintenance for revised concept		$ 78,454
Total years		10
Escalation factor 1976-1983		1.419
Total 10-year field maintenance for revised concept		$1,113,262

Spares

Projected spares = 869 total annual (ref pg 70)(0.35)
= 304 per year

Revised unit cost

$546.27 + (46% x 546.27 new effort) +
($633 x Fca 92% CRC[10] at 500)

$546.27 + (0.46 x $546.27) + ($633 x 0.5375)

$546.27 + $251.28 + $340.24 = $1,137.79
average unit cost

#1,138 avg unit cost x 304 spares/yr =		$ 345,952
Total years		10
Escalation factor 1976-1983		1.419
Total 10-year spares for revised concept		$4,909,059

(8) DDCC - Delamination, Deterioration, Cracking, Chipping, etc

(9) Service life factor of 3,500 hours to 11,000 hours experienced on DC-10 commercial airlines windshields including PPG-112 interlayer (reference 3)

(10) CRC - Crawford's cost reduction curve

TABLE 5. COST ANALYSIS (Continued)

C-130 TRANSPARENCY SYSTEM

OPTION 1 - IMPROVED WINDSHIELD EDGE SEALING

Engineering Hours Estimate

Design: Study materials, establish basic design, adapt to 7 window installations	350
Vendor coordination	140
Preparation and release of detail drawings	224
Establish and release 7 W/S panel configurations	280
Establish and release 7 W/S panel installations	224
Miscellaneous changes - design maintenance	72
	1,290
Stress	350
Weights	40
Checking	140
Materials and processing	56
Project office	56
Release	28
Total Engineering	1,960

TABLE 5. COST ANALYSIS (Continued)

C-130 TRANSPARENCY SYSTEM

OPTION 1 - IMPROVED WINDSHIELD EDGE SEALING

Technical Order Support

TCTO:	Authorize field modification to aircraft	112 hr
	Kit proof and changes	14 hr
		126 hr

Flight Manual

T.O.: Airframe maintenance

Add data to describe, install, and maintain new installation

T.O. revisions	91 hr
Material cost	$ 35

T.O.: Illustrated parts breakdown, add changed data to parts list

T.O. revisions	130 hr
Material cost	$ 50

T.O.: Numerical index

Added changed data	49 hr
Cost	$ 42

Total labor hours	396 hr
Material cost	$127

This estimate is based on inputs from the trapsparency design and technical support functions.

TABLE 5. COST ANALYSIS (Continued)

C-130 TRANSPARENCY SYSTEM

OPTION 1 - IMPROVED WINDSHIELD EDGE SEALING

Annual Field Maintenance Cost/Year[11]

WUC	Hours/Year								Dollars/Year
1111A	975	x	0.67	=	653	x	$14/hr	=	$ 9,142
1111K	1,620	x	0.67	=	1,085	x	$14/hr	=	15,190
1111L	1,800	x	0.67	=	1,206	x	$14/hr	=	16,884
1111M	643	x	0.67	=	431	x	$14/hr	=	6,034
1111N	1,055	x	0.67	=	707	x	$14/hr	=	9,898
1111P	1,284	x	0.67	=	860	x	$14/hr	=	12,040
1111Q	1,825	x	0.67	=	1,223	x	$14/hr	=	17,122
11111	2,264	x	0.67	=	1,517	x	$14/hr	=	21,238
11112	2,029	x	0.67	=	1,359	x	$14/hr	=	19,026
11113	1,729	x	0.67	=	1,158	x	$14/hr	=	16,212
11114	927	x	0.67	=	621	x	$14/hr	=	8,694
11115	681	x	0.67	=	456	x	$14/hr	=	6,384
11118	991	x	0.67	=	664	x	$14/h4	=	9,296
1111C					638				10,740
Σ					12,578				$177,900

Total hours attributed to delamination, deterioration, chipping, and cracking (DDCC) is 86% (ref MAM's).

Total maintenance hours attributed to DDCC is:

$177,900 x 0.86 = $152,994 Other than DDC = $24,906

(11) Hours/year from ALC data, reference 9.
$14/hour includes direct labor, G&A, and overhead.

TABLE 5. COST ANALYSIS (Concluded)

C-130 TRANSPARENCY SYSTEM

OPTION 1 - IMPROVED WINDSHIELD EDGE SEALING

Annual Spares Cost per Year[12]

WUC	No./Year		Unit Cost		Annual Cost
1111A	89 x 0.67 =	60	x 370		22,200
1111K	117 x 0.67 =	78	x 660	=	51,480
1111L	232 x 0.67 =	155	x 600	=	93,000
1111M	50 x 0.67 =	34	x 365	=	12,410
1111N	118 x 0.67 =	79	x 390	=	30,810
1111P	101 x 0.67 =	68	x 465	=	31,620
1111Q	136 x 0.67 =	91	x 662	=	60,242
11111	116 x 0.67 =	78	x 600	=	46,800
11112	148 x 0.67 =	99	x 660	=	65,340
11113	192 x 0.67 =	129	x 647	=	83,463
11114	76 x 0.67 =	51	x 365	=	18,615
11115	95 x 0.67 =	64	x 422	=	27,008
11118	53 x 0.67 =	56	x 425	=	15,300
Σ = 13		1,022	6,631		$558,288

Average unit cost $558,288 ÷ 1,022 = $546.27

Estimated replacements repaired is 15% (from ALC).

Adjusted annual spares cost = 0.85 x 1,022 = 869 x $546.27 = $474,709.

Total spares attributed to DDCC is 86%.

Total annual cost of DDCC spares = 0.86 x $474,709 = $408,250

(12) Unit cost and replacement rates from ALC data (reference 9).

OPTION 2 (CANDIDATE 2 - WINDSHIELD EDGE HEATER)

The problems associated with delaminations, cracking, chipping, and deterioration of panel assemblies can be greatly reduced by the incorporation of windshield edge heaters. Most of the experience with edge heaters to date has been achieved by the airlines. Airline maintenance personnel who have installed these devices have indicated that the service life of the panels has increased by factors of 60 to 100 percent.

The edge heaters consist of very fine wire elements either imbedded in the glass outer ply and the interlayer, or imbedded in a plastic ribbon which is bonded to the outer surface of the inner glass ply (see figure 24). The controls of this device include a thermostat and thermofuse tied into an ac bus. The incorporation of the edge heater is proposed for the primary windshields, center, front (LH and RH), clear vision (LH and RH).

Cost Analysis

The annual savings for incorporating this device is $37,700. The basis for this analysis is a 10-year life cycle cost projection (refer to table 6). Unit costs and design and installation procedures were obtained from Technical Heaters, Inc. Option 1 and Option 2 can be combined for a total annual savings of $174,500.

TABLE 6. COST ANALYSIS

C-130 TRANSPARENCY SYSTEM

OPTION 2 - WINDSHIELD EDGE HEATER INSTALLATION

Summary

Present Concept	
Field Maintenance	$ 324,407
Spares	865,653
Total F/M and spares - 10-year LCC	$1,190,060
Redesign Concept	
Redesign and development	$ 23,858
Field Maintenance	162,196
Spares	432,827
Kit installation	193,800
Total F/M and spares, nonrecurring and recurring R&D - 10-year LCC	$812,681
Net 10-year LCC cost saving	$377,379
Annual (average) savings	$ 37,700

TABLE 6. COST ANALYSIS (Continued)

C-130 TRANSPARENCY SYSTEM

OPTION 2 - WINDSHIELD EDGE HEATER INSTALLATION

Present Concept

Field Maintenance

WUC total	$ 23,255
Total years	10
Escalation factor 1978-1983	1.395 (13)
Total cost 10 years	$324,407

Spares

WUC total	$ 62,054
Total years	10
Escalation factor 1978-1983	1.395
Total cost 10 years	$865,653

Cracked, delamination, and deterioration (DDCC) factor estimated from MAM's 17.7% of 86% (see page 69). Therefore, the estimated adjustment for improved edge seal Option No. 1 is 15.2% for applicable windshields.

Total annual (adjusted) maintenance attributed to DDCC

$152,994(14) x 0.152 = $23,255

Total annual (adjusted) spares attributed to DDCC

$408,250(15) x 0.152 = $62,054

(13) Escalation factors (reference 6)

(14) Maintenance hours attributed to DDCC (refer to table 5)

(15) Unit cost and replacement rates (refer to table 5)

TABLE 6. COST ANALYSIS (Continued)

C-130 TRANSPARENCY SYSTEM

OPTION 2 - WINDSHIELD EDGE HEATER INSTALLATION

Redesign Concept

Recurring Cost

Field Maintenance

Total WUC attributed to delamination (pg 73)	$23,255	
Service life improvement ($23,255 x 0.50)[16]	[11,628]	
Annual field maintenance for revised concept		$ 11,627
Total years		10
Escalation factor 1978-1983		1.395
Total 10-year field maintenance revised concept		$162,196

Spares

Spares attributed to delamination (pg 73)	$62,054	
Projected spares with edge heaters (62,054 x 0.5) =		$ 31,047
Total years		10
Escalation factor		1.395
Total 10-year spares for revised concept		$432,827
Estimated kit cost (edge heater) $625 ea x 151.049[17] =		94,400
Estimated installation cost 10.0 hr x $14 x 710 =		99,400
Total kit cost for fleet		$193,800

(16) Service life projection based on Continental Airlines 727 operational experience

(17) Total aircraft in fleet - 710 aircraft
Kit cost is $125 each for five primary windshields
Projection on 80% CRC for total kit cost = 151.049

TABLE 6. COST ANALYSIS (Continued)

C-130 TRANSPARENCY SYSTEM

OPTION 2 - WINDSHIELD EDGE HEATER INSTALLATION

Redesign Concept

Nonrecurring Cost

Tooling - No effort required.

Engineering

Design	177 hr	
TCTO	68 hr	
Total labor	245 hr	
Rate	$40/hr	
Total labor dollars		$9,800
Material dollars		58
Total engineering dollars		$9,858

Certification

Engineering	$1,500	
Testing	500	
Total certification	$2,000	
Total certification		$14,000

Total nonrecurring cost $23,858

TABLE 6. COST ANALYSIS (Continued)

C-130 TRANSPARENCY SYSTEM

OPTION 2 - WINDSHIELD EDGE HEATER INSTALLATION

Engineering Hours Estimate

Design: Study materials, establish basic design, adapt window installations	35
Vendor coordination	12
Prepare and release drawings	32
Establish and release W/S panel configurations	40
Establish and release W/S panel installations	32
Miscellaneous changes - design maintenance	8
	159
Stress	8
Checking	4
Materials and processing	2
Project office	2
Release	2
Total Engineering	177

TABLE 6. COST ANALYSIS (Concluded)

C-130 TRANSPARENCY SYSTEM

OPTION 2 - WINDSHIELD EDGE HEATER INSTALLATION

Technical Order Support

TCTO:	Authorize field modification to aircraft	12 hr
	Kit proof and changes	10 hr
		22 hr

Flight Manual

T.O.: Airframe maintenance

Add data to describe, install and maintain new installation

T.O. revisions	14 hr
Material cost	$20

T.O.: Illustrated parts breakdown, add changed data to parts list

T.O. revisions	25 hr
Material cost	$35

T.O.: Numerical index -

Add changed data	7 hr
Material cost	$3

Total labor hours	68 hr
Cost	$58

This estimate is based on input obtained from transparency design and technical support functions.

SECTION VI

CH-53 TRANSPARENCY SYSTEM DESIGN IMPROVEMENT TRADE STUDY

CONFIGURATION DESCRIPTION

The CH-53 transparency configuration for the crew compartment includes a three-segment windshield, six forward cabin windows, and two side-viewing windows as shown in figure 26. The windshields are laminated two-ply acrylic panels with a vinyl interlayer including heating provisions. The remaining crew compartment windows are monolithic (single-ply) acrylic as depicted in figure 27.

FAILURE ANALYSIS

Analysis indicates that the most serious problem in maintaining CH-53 transparencies is the excessive abrasions and scratches caused by the windshield wiper operation on acrylic surfaces. Data extracted from AFM 66-1 reveals that scratching, crazing, and cracking contribute approximately 59 percent of the total expenditure for maintaining the CH-53 transparency system. A considerable amount of abrasions is caused by improper cleaning and ground-handling procedures. Field-level maintenance personnel indicate that many of the failures were attributed to delamination caused by the windshield heaters. Additional causes of failures for both windshields and cabin window are environmental and weathering factors.

The description of these failures as diagramed in the fault trees, figures 28 and 29, were assembled from the MAM's program. Figures 30 and 31 present and summarize the more significant How-mals, action taken, and probable cause of failure. The failure mode descriptors in combination with flight hours, maintenance hours, and logistical cost are contained in the sampling MAM's tabulation shown in figure A-4 of Appendix A.

SECTION VI

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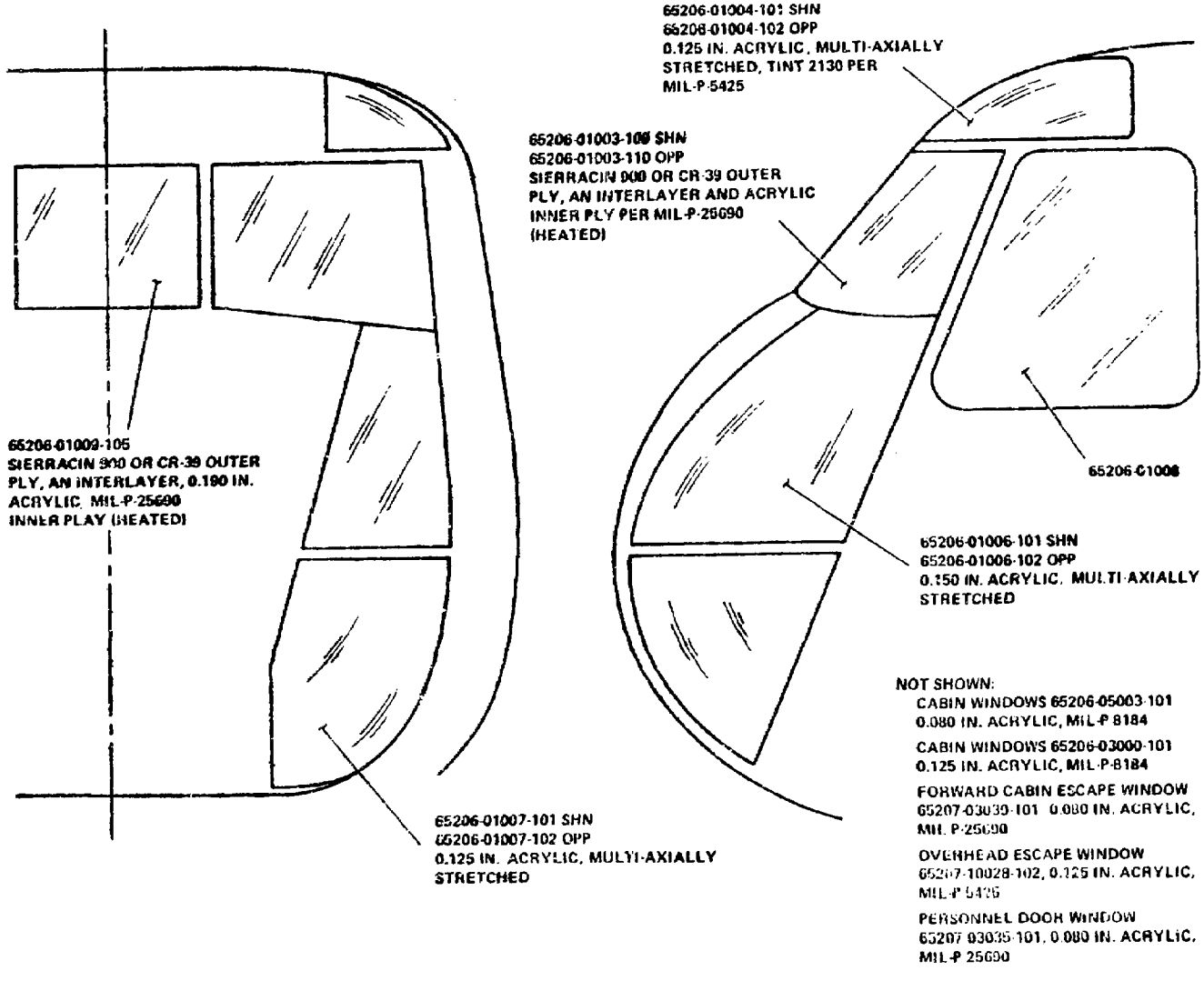


Figure 26. GI-53 Windshield and Cabin Window Configuration

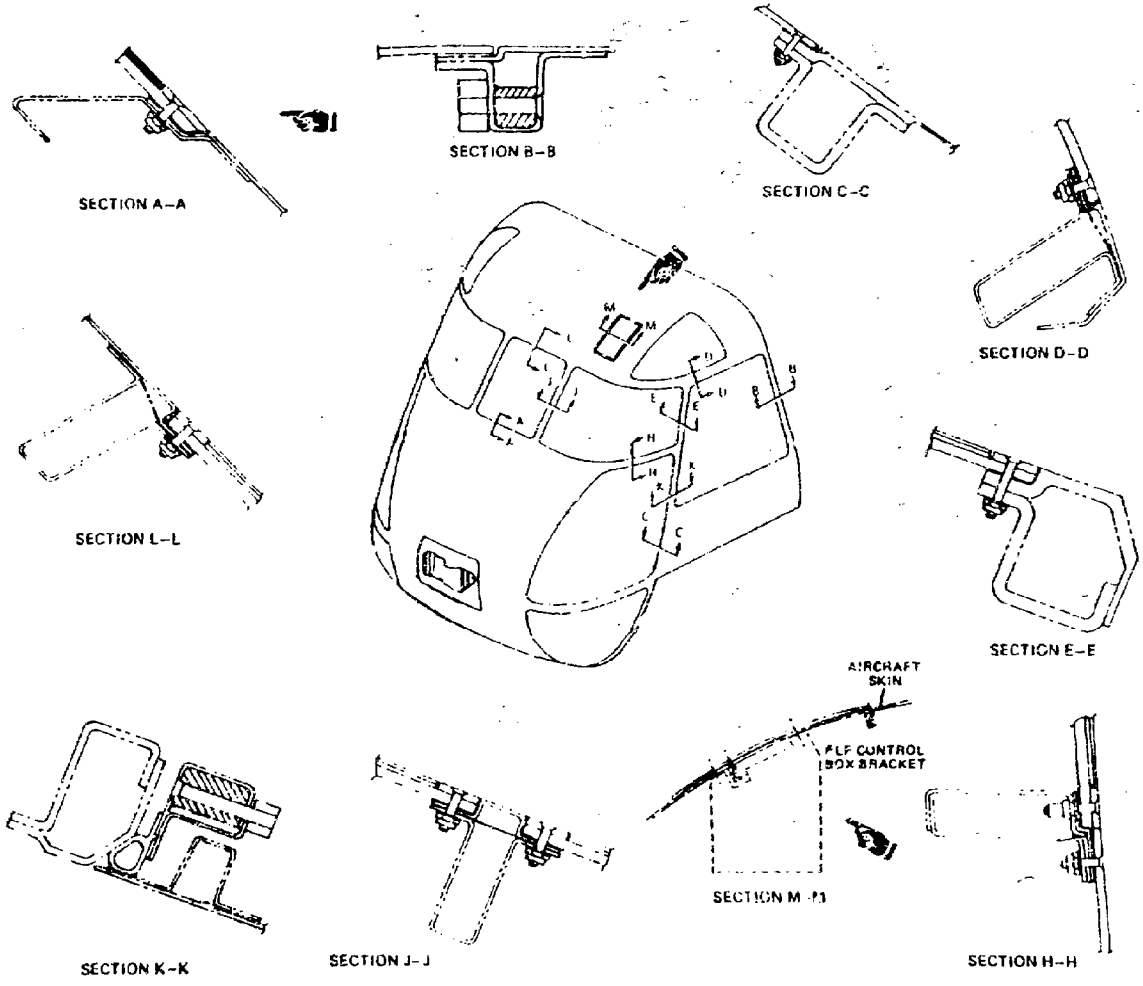


Figure 27. CH-53 Windshield, Cabin Window Support Structure

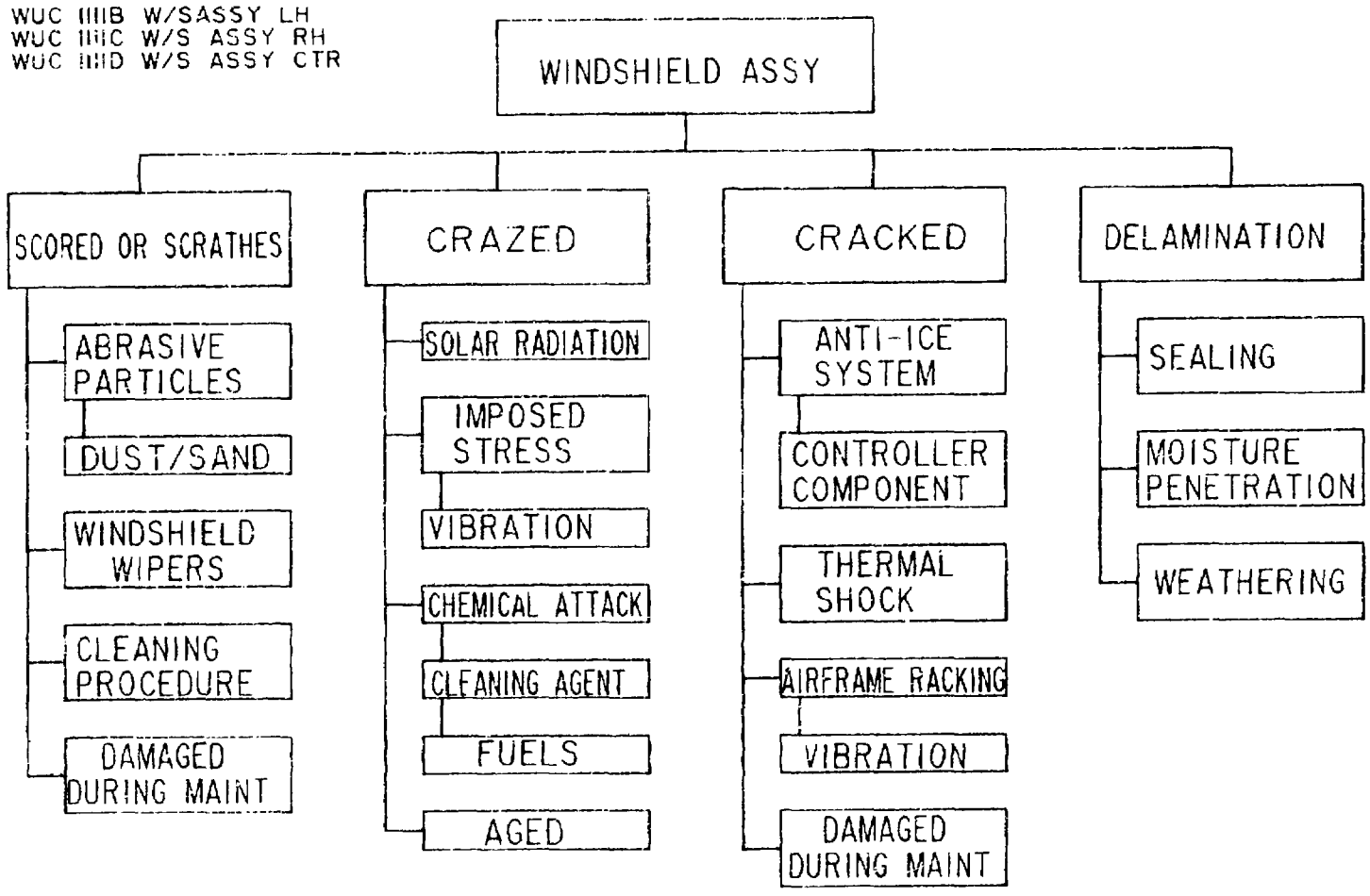


Figure 28. Fault Tree QI-53 Windshield Assembly

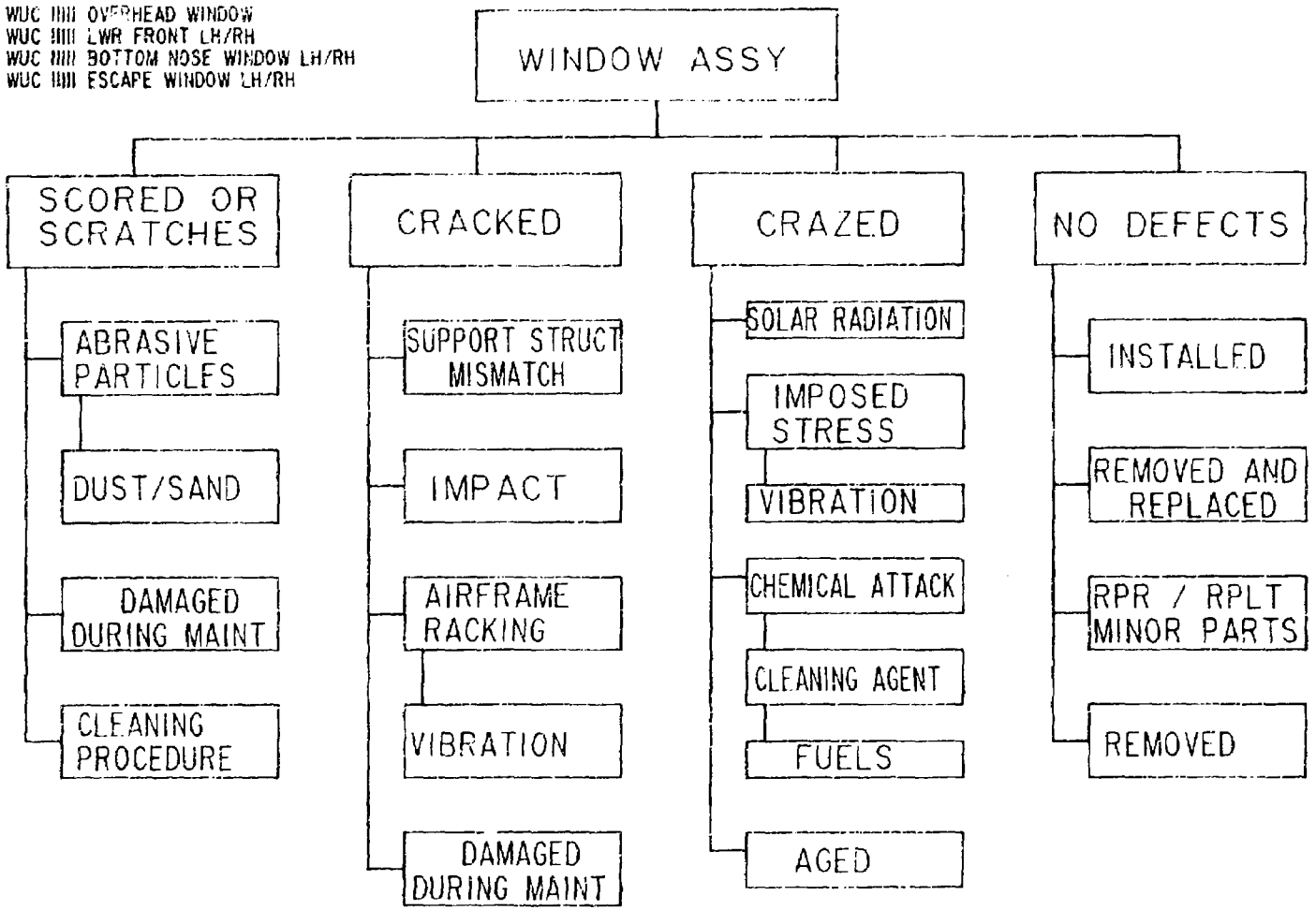


Figure 29. Fault Tree GI-53 Window Assembly

WUC 1111B W/S ASSEMBLY L.H.
WUC 1111C W/S ASSEMBLY R.H.
WUC 1111D W/S ASSEMBLY CTR

HOW MAL	ACTION TAKEN	PROBABLE CAUSE
935 - SCORED OR SCRATCHES	R - REMOVE AND REPLACE P - REMOVED G - REPAIR/REPLACEMENT MINOR PARTS	*WINDSHIELD WIPERS *IMPROPER CARE *DAMAGED DURING MAINTENANCE
605 - CRAZED	R - REMOVE AND REPLACE G - RPR/RPLT MINOR PARTS	*SOLAR RADIATION *IMPOSED STRESS *CHEMICAL ATTACK
190 - CRACKED	R - REMOVE AND REPLACE G - RPR/RPLT MINOR PARTS P - REMOVED F - REPAIR	*ANTI-ICE SYSTEM *THERMAL SHOCK *AIRFRAME RACKING
846 - DELAMINATION	R - REMOVE AND REPLACE Q - REMOVED G - RPR/RPLT MINOR PARTS	*SEALING *WEATHERING

Figure 30. CH-53 Windshield Assembly Failure Analysis Summary

WUC 11111 OVERHEAD WINDOW
WUC 11111 LWR FRONT LH/RH
WUC 11111 BOTTOM NOSE WINDOW CH/RH
WUC 11111 ESCAPE WINDOW CH/RH

HOW MAL	ACTION TAKEN	PROBABLE CAUSE
935 - SCORED AND SCRATCHES	G - RPR/RPLT MINOR PARTS R - REMOVE AND REPLACE P - REMOVED	*IMPROPER CARE *DAMAGED DURING MAINTENANCE
190 - CRACKED	R - REMOVE AND REPLACE A - BENCH CHECK AND REPAIRED G - RPR/RPLT MINOR PARTS	*AIRFRAME RACKING
605 - CRAZED	R - REMOVE AND REPLACE G - RPR/RPLT MINOR PARTS V - CLEAN	*SOLAR RADIATION *IMPOSED STRESS *CHEMICAL ATTACK
799 - NO DEFECTS	Q - INSTALLED	*INTERRELATED WITH OTHER HOW MAL CODES

Figure 31. CH-53 Window Assembly Failure Analysis Summary

CANDIDATE DESIGN IMPROVEMENTS

It was concluded from examination of the failure analysis data and results that the following candidate improvements should be considered and investigated:

1. Incorporate glass outer ply and PPG liner material layer bonded to the inner ply of acrylic for pilot's and copilot's windshields for improved abrasion resistance.

2. Incorporate PPG-liner material bonded to the inner and outer surfaces of the center windshield for improved abrasion resistance.

3. Incorporate improved windshield frame for improved sealing.

4. Incorporate PPG-liner material bonded to the inner and outer surfaces of cabin windows for improved abrasion resistance.

5. Incorporate "lube blade" windshield wiper.

INVESTIGATION AND RATIONALE FOR SELECTED CANDIDATES

CANDIDATE 1 - GLASS AND PPG-LINER MATERIAL FOR PILOT'S AND COPILOT'S WINDSHIELD

The predominant failure modes for the pilot's and copilot's windshield are caused by the abrasions and scratching due to windshield wipers. The elimination of the problem can best be accomplished by the incorporation of a glass outer ply. To reduce the abrasions that are causing degraded optical qualities to the inner surface, the incorporation of a new PPG-liner material laminate is proposed. This configuration results in a multilaminate of glass, acrylic, and PPG urethane (liner material).

CANDIDATE 2 - STRETCHED ACRYLIC AND PPG-LINER MATERIAL FOR CENTER WINDSHIELD

The principal problem affecting the optical qualities of the center windshield panel is attributed to excessive abrasions and scratching. The inclusion of the PPG-liner material bonded to the outer surfaces of both the inner and outer plies is believed to offer a significant improvement in service life.

CANDIDATE 3 - WINDSHIELD FRAME MODIFICATION FOR IMPROVED SEALING

The problem of delamination for this configuration is generally attributed to the windshield heater. Maintenance personnel indicate that the onset of peripheral delamination is most often caused by moisture penetration. It is therefore proposed that improved edge sealing be accomplished by a small modification of the windshield support frames.

CANDIDATE 4 - PPG-LINER MATERIAL FOR CABIN WINDOWS

The remaining crew compartment windows are also subject to high levels of abrasion and scratching similar to that experienced by the primary windshields. Although flight crew expressed the desire that the remaining crew compartment window optical qualities be improved, they are more tolerant of scratches and abrasions of these windows. It is for this reason that the replacement rates for the crew compartment windows are considerably less than the primary windshields. As these aircraft increase in age, it is expected the replacement rate will increase significantly due to constant exposure to environmental and weathering factors. It is therefore recommended that design improvements for these windows be considered as a follow-on study.

CANDIDATE 5 - "LUBE BLADE" WINDSHIELD WIPER

The scratching of the windshield panels is believed to be induced by the initial wiper blade action on a dusty grime-covered surface. The "lube blade"

concept directs the wash fluid at the immediate point of contact. This concept offers potential improvement where it is desired to retain the plastic-type windshield.

SELECTED TRADE STUDIES

Based on the cost analysis as contained in this section, the following candidates are recommended for implementation. These design improvements are presented as "options" for the incorporation of one or more features designed to reduce logistical support costs.

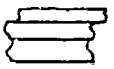
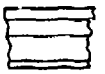
The analyses of Options 1, 2, and 3 were performed so that costs for the individual options could be determined, or the cost of the options collectively be combined. It should be noted, however, that Option 4 should not be added to 1, 2, and 3 because they have varying impact on common maintenance effort and/or spare parts.

PROPOSED CHANGE OPTIONS

OPTION 1 (CANDIDATE 1 - GLASS AND PPG LINER MATERIAL FOR PILOT'S AND COPILOT'S WINDSHIELD)

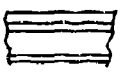
The proposed change to significantly reduce or eliminate the scratching and abrasion problems is to incorporate a multilaminate glass, acrylic, and PPG-liner material configuration for the pilot's and copilot's windshield assemblies. The existing design consists of an inner and outer ply of stretched acrylic with a PVB interlayer as shown in figure 27. The proposed design (see figure 32) is also configured as a multilaminate construction. The outer ply is 0.050-inch Chemcor glass to provide protection against scratching and spalling. For improved resistance to cold chipping, a PPG 112 interlayer is recommended. The remaining plies consist of 0.190-inch stretched acrylic structural ply bonded to a layer of 0.020-inch PPG-liner material.

OPTION 1 - GLASS AND PPG-LINER MATERIAL FOR PILOT'S AND COPILOT'S WINDSHIELDS

Item	Area ($in.^2$/AV)	Existing design: Config & thickness (in.)	Existing design: Wt (lb)	Proposed design: Config & thickness (in.)	Proposed design: Wt (lb)	Weight penalty (lb)
Windshield (pilot/copilot)	1,630	 0.062 S-900 0.075 PVB 0.190 S/A	22.9	 0.050 Chemcor 0.057 I/L 0.190 S/A 0.020 PPG-LM	25.6	2.7

S/A = stretched acrylic
I/L = interlayer
PPG-LM = PPG urethane liner material
PVB = poly vinyl butyral
AV = air vehicle

OPTION 2 - STRETCHED ACRYLIC AND PPG LINER MATERIAL FOR CENTER WINDSHIELD

Item	Area ($in.^2$/AV)	Existing design: Config & thickness (in.)	Existing design: Wt (lb)	Proposed design: Config & thickness (in.)	Proposed design: Wt (lb)	Weight penalty (lb)
Center windshield	576	 0.062 S-900 0.075 PVB 0.190 S/A	8.1	 0.062 PPG-LM 0.055 I/L 0.190 S/A 0.020 PPG-LM	8.1	Negligible

OPTION 3 - WINDSHIELD FRAME MODIFICATION FOR IMPROVED SEALING

Weight increase considered negligible

Figure 32. CH-53 Transparency Design Data

The liner material being considered for the applications is currently being developed by PPG Industries. The new liner material will significantly improve the abrasion resistance of current plastic glazing materials. This new liner can be applied to the inboard and outboard surfaces of glass, acrylic, and polycarbonate glazing materials. Based on PPG estimates, use of this liner on the inboard surfaces of the center, pilot's, and copilot's windshields should increase the life of those surfaces by a factor of 3 to 4. Glass spall sheets are recommended for the outboard surfaces of the pilot's and copilot's windshields to increase service life of those panels subjected to windshield wiper operation.

Cost Analysis

The annual savings in the cost of maintaining and sparing option 1, the incorporation of the PPG-liner material in the pilot's and copilot's windshields, is estimated to be $45,300. This is based on a cost trade analysis (refer to table 7) developed for a 10-year life cycle costing. The source of maintenance hours, number of spares. and unit cost was data provided by the Warner Robins ALC, reference 10. An additional source for the cost analysis supporting this study was the data collected from the field audits of the original study plus the data obtained from the operational Air Force Base listed in Section II. The combination of these data was correlated with the AFM 66-1 MDC data used as the data base for all these studies. Options 1, 2, and 3 can be combined for a total annual savings of $66,600.

Reference 10. Donald M. Bohler, Lt Col USAF, "Acquisition of Logistical Support and Cost Data for CH-53 Windshield and Window System," AFLC Letter WR-ALC/MMSRCB, Headquarters Warner Robins Air-logistics Center (AFLC), Robins Air Force Base, Georgia 31098, 21 March 1979.

TABLE 7. COST ANALYSIS

CH-53 TRANSPARENCY SYSTEM

OPTION 1 - GLASS AND PPG-LINER MATERIAL FOR PILOT'S AND COPILOT'S WINDSHIELDS

Summary

Present Concept	
Field Maintenance	$ 108,903
Spares	968,240
Total F/M and spares - 10-year LCC	$1,077,143
Redesign Concept	
Redesign and development	$ 32,785
Field Maintenance	64,068
Spares	527,438
Total F/M, spares and nonrecurring and recurring R&D - 10-year LCC	$624,291
10-year LCC savings	$452,852
Annual (average) savings	$ 45,300

TABLE 7. COST ANALYSIS (Continued)

CH-53 TRANSPARENCY SYSTEM

OPTION 1 - GLASS AND PPG-LINER MATERIAL FOR PILOT'S AND COPILOT'S WINDSHIELDS

Present Concept

Field Maintenance

WUC partial 1111B and 1111C (see page 97)	$ 8,890
Total years	10
Escalation factor 1978-1983	1.225 (18)
Total cost 10 years	$108,903

Spares

WUC partial 1111B and 1111C (see page 97)	$ 79,040
Total years	10
Escalation factor 1978-1983	1.225
Total cost 10 years	$968,240

(18) Escalation factors (reference 6)

TABLE 7. COST ANALYSIS (Continued)

CH-53 TRANSPARENCY SYSTEM

OPTION 1 - GLASS AND PPG-LINER MATERIAL FOR PILOT'S AND COPILOT'S WINDSHIELDS

Redesign Concept - Nonrecurring

Tooling - No effort required.

Engineering

Design	348		
TCTO	100		
Total engineering labor	448		
Engineering labor rate		$40/hr	
Engineering labor dollars			$17,920
Engineering material			45
Total engineering			$17,965

Certification

Engineering	$ 750	
Testing	$7,500	
Panel fabrication (3 x $2,190) (19)	$6,570	
Total certification/panel	$14,820	
Panel certification x 1 L/H		$14,820
Total nonrecurring cost		$32,785

(19) Current panel cost $1,460/avg unit
Added effort (50% current) 730
(reference 1) $2,190/avg unit

(19) Current panel cost (reference 10)

TABLE 7. COST ANALYSIS (Continued)

CH-53 TRANSPARENCY SYSTEM

OPTION 1 - GLASS AND PPG-LINER MATERIAL FOR PILOT'S AND COPILOT'S WINDSHIELDS

Redesign Concept - Recurring Cost

Field Maintenance

Total WUC attributed to SDCC[20] (ref page 97) 415 hr at $14/hr =	$ 5,810
Service life improvement $5,810 x 0.63 =	-3,660
Reduction of field maintenance attributed to SDCC	$ 2,150
Total WUC attributed to other than SDCC 220 at $14/hr =	3,080
Annual field maintenance for release concept	5,230
Total years	10
	$52,300
Escalation factor 1978-1983	1.225
Total 10-year field maintenance revised concept	$64,068

Spares

	LH	RH
Total annual spares	38	26
	0.35	0.35
0.35% reduction	13.3	9.1
Total years	10	10
	133	91
Less spares on hand	-18	-3
Projected spares	115	88
Revised unit cost (ref 2) remaining unchanged	LH	RH
Current unit cost	$1,480	$1,440
% added effort (45% current unit cost)	666	648
	$2,146	$2,088
Escalation factor 1978-1983	1.225	1.225
	$2,629	$2,558

LH 115 units at $2,629 =	$302,335
RH 88 units at $2,558 =	$225,104
Total 10-year spares for redesigned concept	$527,438

(20) Maintenance hours attributed to SDCC denotes How-Mal's - scored, scratched, delaminated, crazed, cracked, etc.

TABLE 7. COST ANALYSIS (Continued)

TRANSPARENCY SYSTEM

OPTION 1 - GLASS AND PPG-LINER MATERIAL FOR PILOT'S AND COPILOT'S WINDSHIELDS

Engineering Hours Estimate

Design study materials, establish basic design, adapt to two-window installation	76
Vendor coordination	30
Establish and release two W/S RH/LH configurations	60
Establish and release two W/S installations	48
Miscellaneous changes - design maintenance	24
Subtotal	238
Stress	60
Checking	24
Materials and processing	10
Project office	10
Release	6
Subtotal	110
Total Engineering	348

TABLE 7. COST ANALYSIS (Continued)

CH-53 TRANSPARENCY SYSTEM

OPTION 1 - GLASS AND PPG-LINER MATERIAL FOR PILOT'S AND COPILOT'S WINDSHIELDS

Technical Order Support

TCTO:	Authorize field modification to aircraft	36 hours
	Kit proof and changes	6 hours
		42 hours

Flight Manual

T.O.: Airframe maintenance

Add data to describe, install and maintain new installation

T.O. revisions	15 hours
Material cost	$10

T.O.: Illustrated parts breakdown, add changed data to parts list

T.O. revisions	35 hours
Material cost	$23

T.O.: Numerical Index - 1 pp

Add changed data	8 hours
Material cost	$12

Total labor hours	100 hours
Cost	$45

This estimate is based on input obtained from transparency design and technical support functions.

TABLE 7. COST ANALYSIS (Concluded)

CH-53 TRANSPARENCY SYSTEM

Annual Field Maintenance Cost/Years[21]

WUC	Total Hr/Yr	Option 1 Hr	Option 1 $	Option 2 Hr	Option 2 $	Option 3 Hr	Option 3 $	Total
1111B	574	341	4,774			281	3,262	$ 8,036
1111C	492	294	4,116			194	2,772	6,888
1111D	205			161	2,254	44	616	2,870
	1,271	635	8,890	161	2,254	475	6,650	$17,794

Maintenance rate $14.00/hr from K015 IROS.
$14.00/hour includes direct labor, G&A, and overhead.
Lube blade factor 35% of pilot's and copilot's windshields maintenance effect.

Annual Spares Cost/Year[22]

WUC	Unit Cost	Option 1 Spares/Cost	Option 2 Spares/Cost	Option 3 Spares/Cost
1111B	$1,480	32/$47,360		6/$ 8,880
1111C	$1,440	22/$31,680		4/$5,760
1111D	$1,010		17/$17,170	3/$ 3,030
		54/$79,040	17/$17,170	13/$17,670

	Spares/Cost
Option 1	54/$ 79,040
Option 2	17/ 17,170
Option 3	13/ 17,670
Total spares	84/$113,880

(21) Hours/year from ALC data, reference 10.

(22) Unit costs and replacement rates from ALC data, reference 10.

OPTION 2 (CANDIDATE 2 - STRETCHED ACRYLIC AND PPG LINER MATERIAL FOR CENTER WINDSHIELD)

The center windshield panel is also subject to excessive scoring and scratching due to ground handling and cleaning procedures and to environmental factors. It is therefore proposed that a multilaminate containing two plies of PPG-liner material with an improved PPG-112 interlayer (0.055-inch) be substituted for the existing PVB interlayer. The proposed configuration will consist of a 0.062-inch PPG-liner material outer ply, the PPG-112 interlayer, and a 0.020-inch outer layer of PPG-liner material bonded to a 0.190-inch stretched acrylic structural ply. Figure 32 shows a comparison of the existing design and the proposed design. The principal advantage of the proposed configuration is a significant increase in abrasion resistance for negligible weight change.

Cost Analysis

The annual savings in the cost of maintaining and providing spares for option 2, i.e., the incorporation of a multilaminate PPG-liner material concept for the center windshield, is estimated to be $10,200. Table 8 presents a detailed cost trade analysis as proposed for this configuration. The data source used in this option is the same as that discussed for option 1. Options 1, 2, and 3 can be combined for a total annual savings of $66,600.

TABLE 8. COST ANALYSIS

CH-53 TRANSPARENCY SYSTEM

OPTION 2 - STRETCHED ACRYLIC AND PPG-LINER MATERIAL FOR CENTER WINDSHIELD

Summary

Present Concept	
Field Maintenance	$ 27,612
Spares	210,333
Total F/M and spares - 10-year LCC	$237,945
Redesign Concept	
Redesign and development	$ 22,645
Field Maintenance	19,943
Spares	93,340
Total F/M, spares and nonrecurring and recurring R&D - 10-year LCC	$135,928
10-year LCC savings	$102,017
Annual (average) savings	$ 10,200

TABLE 8. COST ANALYSIS (Continued)

CH-53 TRANSPARENCY SYSTEM

OPTION 2 - STRETCHED ACRYLIC AND PPG-LINER MATERIAL FOR CENTER WINDSHIELD

Present Concept

Field Maintenance

WUC partial 1111D (see Option 1, page 97)	$ 2,254
Total years	10
Escalation factor 1978-1983	1.225 (23)
Total cost 10 years	$27,612

Spares

WUC partial 1111D (see Option 1, page 97)	$ 17,170
Total years	10
Escalation factor 1978-1983	1.225
Total cost 10 years	$210,333

(23) Escalation factors (reference 6)

TABLE 8. COST ANALYSIS (Continued)

CH-53 TRANSPARENCY SYSTEM

OPTION 2 - STRETCHED ACRYLIC AND PPG-LINER MATERIAL FOR CENTER WINDSHIELD

Redesign Concept - Nonrecurring

Tooling - No effort required.

Engineering

Design	172 hr	
TCTO	74 hr	
Total engineering labor	246 hr	
Engineering labor rate	$40/hr	
Engineering labor dollars	$9,840	
Engineering material	10	
Total engineering	$9,850	$9,850

Certification

Current panel cost	$ 1,010/unit	
Added effort (50% current)	505/unit	
	$ 1,515/unit	
Number of panels	3 units	
	$ 4,545 total	
Engineering	$ 750	
Testing	$ 7,500	
Total certification/panel	$12,795	$12,795
Total nonrecurring cost		$22,645

TABLE 8. COST ANALYSIS (Continued)

CH-53 TRANSPARENCY SYSTEM

OPTION 2 - STRETCHED ACRYLIC AND PPG-LINER MATERIAL FOR CENTER WINDSHIELD

Redesign Concept - Recurring Cost

Field Maintenance

Total WUC attributed to SDCC[24] (see page 97) 71 hr at $14/hr =	$ 994
Service life improvement $994 x 0.63 =	-626
Reduction of field maintenance attributed to SDCC	$ 368
Total WUC attributed to other than SDCC 90 hr at $14/hr =	$ 1,260
Annual field maintenance for revised concept	1,628
Total years	10
10-year field maintenance for revised concept	$16,280
Escalation factor 1978-1983	1.225
Total 10-year field maintenance revised concept	$19,943

Spares

Center total annual spares	20
Reduction factor	0.35
	7
Total years	10
	70
Less spares on hand	-18
Projected total number of spares	52 units
Revised unit cost	
Remaining unchanged current unit cost	$ 1,010
% added effort (45% of current unit cost)	455
Adjusted current unit cost	$ 1,465
Escalation factor 1978-1983	1.225
	$ 1,795
	52 units
Total 10-year spares for redesigned concept	$93,340

(24) Maintenance hours attributed to SDCC denotes How-Mal's - scored, scratched, delaminated, crazed, cracked. SDCC = 71 hr other than SDCC = 161 - 71 = 90 (estimate from MAM's).

TABLE 8. COST ANALYSIS (Continued)

CH-53 TRANSPARENCY SYSTEM

OPTION 2 - STRETCHED ACRYLIC AND PPG-LINER MATERIAL FOR CENTER WINDSHIELD

Engineering Hours Estimate

Design study materials, establish basic design, adapt to one-window installation	38
Vendor coordination	15
Establish and release center windshield configuration	30
Establish and release center windshield installations	24
Miscellaneous changes - design maintenance	12
Subtotal	119
Stress	30
Checking	12
Materials and processing	4
Project office	4
Release	3
Subtotal	53
Total Engineering	172

TABLE 8. COST ANALYSIS (Concluded)

CH-53 TRANSPARENCY SYSTEM

OPTION 2 - STRETCHED ACRYLIC AND PPG-LINER MATERIAL FOR CENTER WINDSHIELD

Technical Order Support

TCTO:	Authorize field modification to aircraft	27 hours
	Kit proof and changes	4 hours
		31 hours

Flight Manual

T.O.: Airframe maintenance

Add data to describe, install and maintain new installation

T.O. revisions	11 hours
Material cost	$3

T.O.: Illustrated parts breakdown, add changed data to parts list

T.O. revisions	26 hours
Material cost	$5

T.O.: Numerical Index

Add changed data	6 hours
Material cost	$2

Total labor hours	74 hours
Cost	$10

This estimate is based on input obtained from transparency design and technical support functions.

OPTION 3 (CANDIDATE 3 - WINDSHIELD FRAME MODIFICATION FOR IMPROVED SEALING)

Data from both field audits of operation level and from the AFM 66-1 MDC system indicates that 35 percent of windshield failures are attributed to delaminations, cracking, etc, due to moisture penetration. A secondary effect is the onset of corrosion, especially for those helicopters operating in the coastal areas. In order to substantially reduce this problem, it is proposed that the framing and support modification as shown on figure 33 be incorporated. The principal modification to accomplish this change is a seal plate that is affixed to the juncture of the windshield column and windshield panel edge member.

Cost Analysis

The annual savings for incorporating this modification is $11,100. The basis for this analysis is a 10-year life cycle cost projection (refer to table 9). Specific expenditures for the maintenance hours and associated costs were developed from estimates made from the allowances from windshield panel edge members and the work unit code assigned to frames. Options 1, 2, and 3 can be combined for a total annual savings of $66,600.

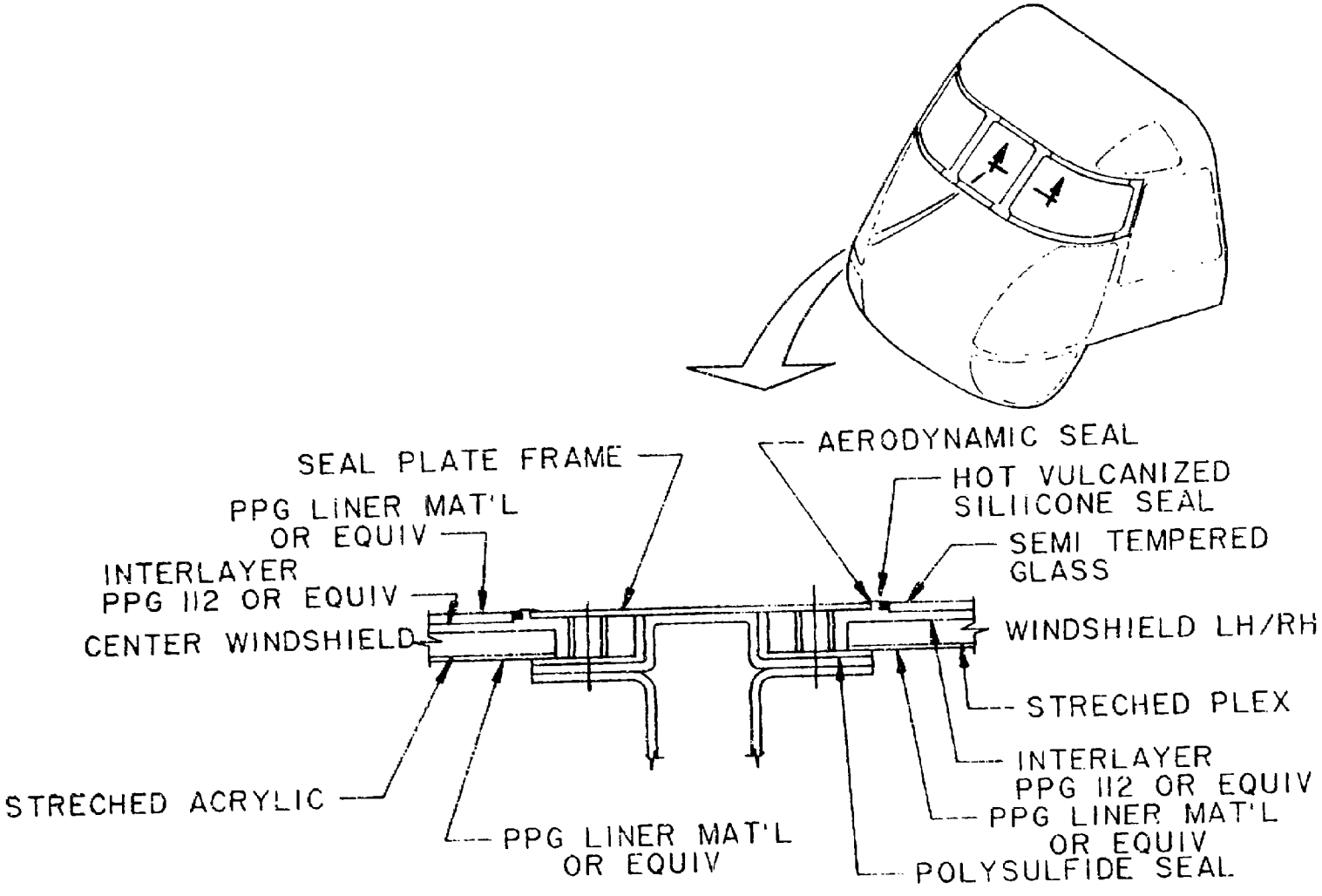


Figure 33. CI-53 Proposed Windshield Panels Arrangement

TABLE 9. COST ANALYSIS

CH-53 TRANSPARENCY SYSTEM

OPTION 3 - WINDSHIELD FRAME MODIFICATION FOR IMPROVED SEALING

Summary

Present Concept	
Field Maintenance	$ 81,462
Spares	216,458
Total F/M and spares - 10-year LCC	$297,920
Redesign Concept	
Redesign and development	$ 49,043
Field Maintenance	51,107
Spares	86,579
Total F/M, spares and nonrecurring and recurring R&D - 10-year LCC	$186,729
10-year LCC savings	$111,191
Annual (average) savings	$ 11,100

TABLE 9. COST ANALYSIS (Continued)

CH-53 TRANSPARENCY SYSTEM

OPTION 3 - WINDSHIELD FRAME MODIFICATION FOR IMPROVED SEALING

Present Concept

Field Maintenance

WUC partial 1111B, 1111C, and 1111D (See Option 1, page 97)	$ 6,650
Total years	10
Escalation factor 1978-1983	1.225(25)
Total cost 10 years	$ 81,462

Spares

WUC partial 1111B, 1111C, and 1111D (See Option 1, page 97)	$ 17,670
Total years	10
Escalation factor 1978-1983	1.225
Total cost 10 years	$216,458

(25) Escalation factors (reference 6)

TABLE 9. COST ANALYSIS (Continued)

CH-53 TRANSPARENCY SYSTEM

OPTION 3 - WINDSHIELD FRAME MODIFICATION FOR IMPROVED SEALING

Redesign Concept, Nonrecurring

Tooling (Windshield frame, center RH/LH)

Strip		
PFP	10 hours	
HDP	100 hours	
HTF	40 hours	
Molded silicone seal		
Mold	40 hours	
SRD	25 hours	
Total tooling hours	215 hours	
Labor rate	$40/hours	
Total tooling labor		$ 8,600
Tooling material at $6.00/hr		1,290
Total tooling dollars per each configuration		$ 9,890
Three configurations		3
Total tooling		$29,670

Engineering

Design	322	
TCTO	87	
Total engineering labor	409	
Engineering labor rate	$40/hour	
Engineering labor dollars		$16,360
Engineering material		13
Total engineering		$16,373

Certification

Engineering	By comparison	$1,500
Testing	to similar parts	
Frame fabrication		
Total certification/panel		$1,500
Total certification 2 panel frames		3,000
Total nonrecurring cost		$49,043

TABLE 9. COST ANALYSIS (Continued)

CH-53 TRANSPARENCY SYSTEM

OPTION 3 - WINDSHIELD FRAME MODIFICATION FOR IMPROVED SEALING

Redesign Concept - Recurring Cost

Field Maintenance

Total WUC attributed to SDCC[26] 281 hr at $14/hr =	$ 3,934
Service life improvement $3,934 x 0.63 =	-2,478
Reduction of field maintenance attributed to SDCC	$ 1,456
Total WUC attributed to other than SDCC 194 hr at $14/hr =	2,716
Annual field maintenance for release concept	$ 4,172
Total years	10
	$41,720
Escalation factor 1978-1983	1.225
Total 10-year field maintenance revised concept	$51,107

Projected Spares (Windshield)

	LH	CTR	RH
No. of spares	38	20	26
Reduction factor	0.35	0.35	0.35
	13.3	7	9.1
Total years	10	10	10
	133	70	91
15% of spares R&R for How-Mal Code 190	0.15	0.15	0.15
	20	10.5	13.6
Projected unit cost[22]	$ 2,140	$ 1,465	$ 2,088
	$42,800	$15,382	$28,397

Total projected spares $42,800 + $15,382 + $28,397 = $86,579

Projected unit cost[22]

LH = $1,480 x 1.45 = $2,146
RH = $1,440 x 1.45 = $2,088
CTR = $1,010 x 1.45 = $1,465

(26) SDCC denotes How-Mal's SDCC = 281 hours, other than SDCC = 194 hours - scored, scratched, delaminated, crazed, cracked. (Estimated from MAM's.)

TABLE 9. COST ANALYSIS (Continued)

CH-53 TRANSPARENCY SYSTEM

OPTION 3 - WINDSHIELD FRAME MODIFICATION FOR IMPROVED SEALING

Engineering Hours Estimate

Design study materials, establish basic design, adapt to three window installations	80
Vendor coordination	15
Prepare and release drawing of three frames	54
Establish and release 3 W/S configurations	30
Establish and release 3 W/S installations	24
Miscellaneous changes - design maintenance	12
Subtotal	215
Stress	60
Checking	24
Materials and processing	10
Project office	10
Release	3
Subtotal	107
Total Engineering	322

TABLE 9. COST ANALYSIS (Concluded)

CH-53 TRANSPARENCY SYSTEM

OPTION 3 - WINDSHIELD FRAME MODIFICATION FOR IMPROVED SEALING

Technical Order Support

TCTO:	Authorize field modification to aircraft	33 hours
	Kit proof and changes	4 hours
		37 hours

Flight Manual

T.O.: Airframe maintenance

Add data to describe, install, and maintain new installation

T.O. revisions	13 hours
Material cost	$5

T.O.: Illustrated parts breakdown, add changed data to parts list

T.O. revisions	30 hours
Material cost	$5

T.O.: Numerical Index added change data

T.O. revisions	7 hours
Material cost	$3

Total labor hours	87 hours
Cost	$13

This estimate is based on input obtained from transparency design and technical support functions.

OPTION 4 (CANDIDATE 5 - "LUBE BLADE" WINDSHIELD WIPER)

At the outset of this program, the most prevalent problem area that surfaced with the helicopter transparency systems was the extensive damage caused by windshield wipers abrading and scratching plastic-type windshields. In some cases, some damage to glass-type windshields was attributed to the windshield wiper. Both the military and industry have been aware of this problem for a considerable length of time. Design and research organizations have and are presently devoting considerable effort to improve the windshield wiper.

Very knowledgeable field-level personnel state that most of the damage to the windshield occurs during the initial wiping action. Much of the damage is caused by fine layers of grime and dust that collect on the windshield. In the case of the CH-53 wiper system, the wash fluid system can be activated, and 2 seconds later the wiper arm starts its wiping action. The spray from a tubular manifold ("spray tube") is affixed to the wiper blade (figure 34), and applied in a dispersed pattern. The spray pattern from the manifold does not provide uniform saturation of the wiped surface. Consequently, scratching of the windshield, especially from wiper blades that harden from age, results.

It is therefore proposed that the "lube blade" concept as shown in figures 35 and 36 be incorporated as means of eliminating this problem. The principle utilized by the "lube blade" is dispersal of the wash fluid, through a jet stream, providing a uniform coverage across the full length of the wiper blade. The wash fluid is dispersed at the wiper blade wiping tip, as shown in figure 35. The fluid is pumped into an integral tubular manifold and dispersed through jet ports approximately 1 inch apart. The lower part of the wiper blade is formed to act as a valve, blocking off the jets on the retreating side of the blade and concentrating all the flow to the advancing side of the wiper blade. The concentration of the wash fluid at the "tip" point of contact will lubricate the surface and prevent scratching of the windshield surface.

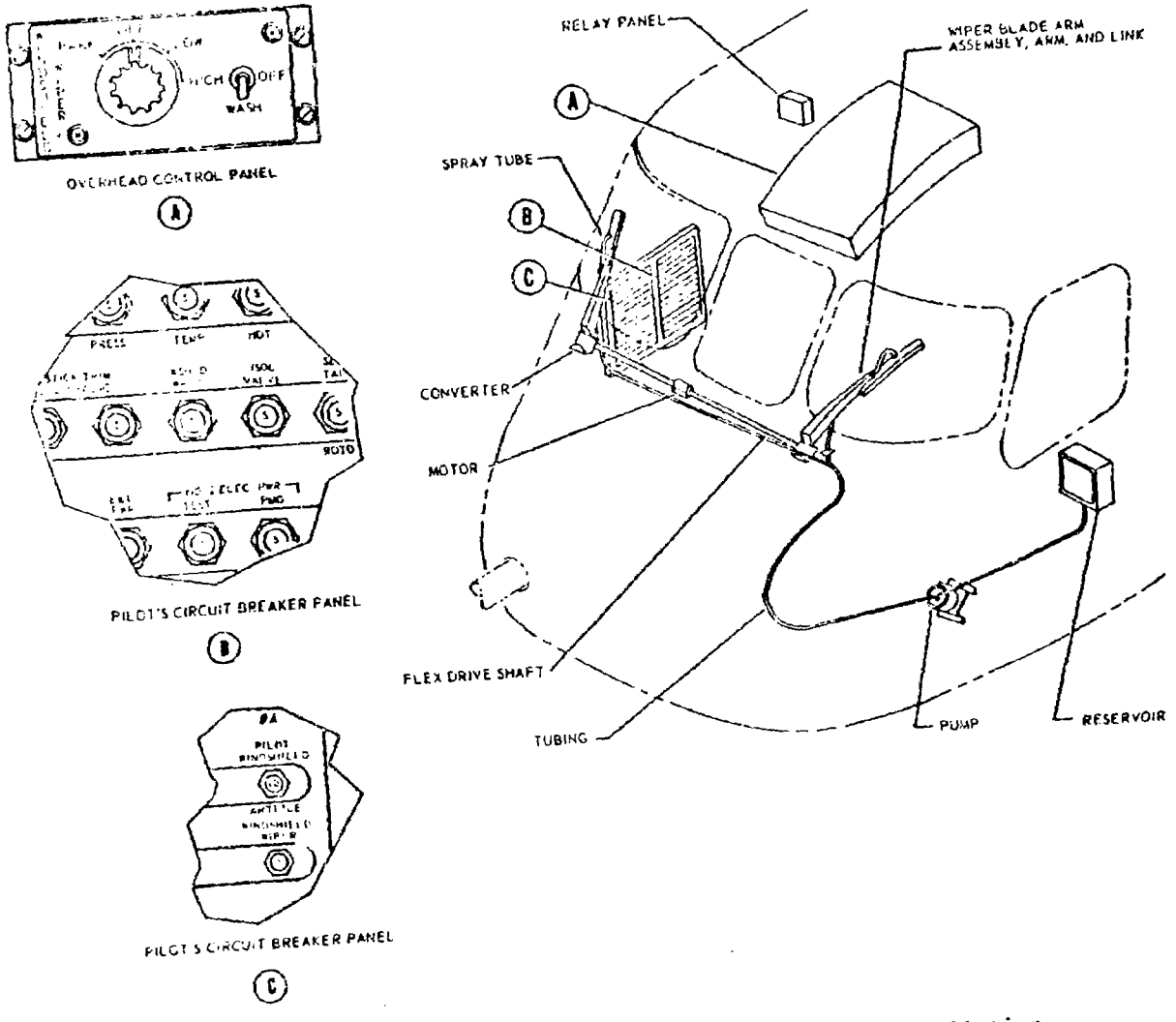


Figure 34. OH-53 Existing Windshield Wiper Installation

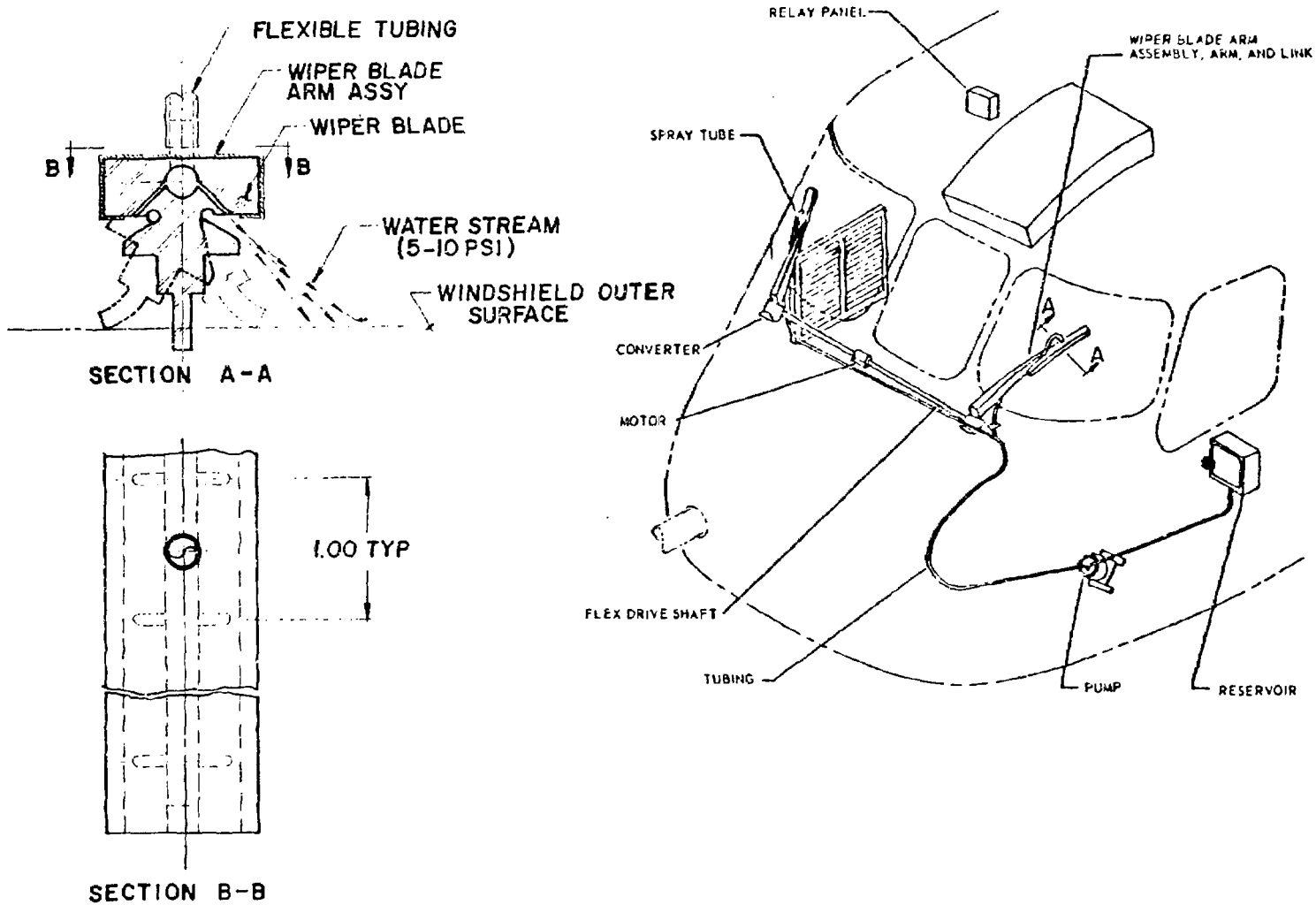


Figure 35. CH-53 Proposed Windshield Wiper Installation

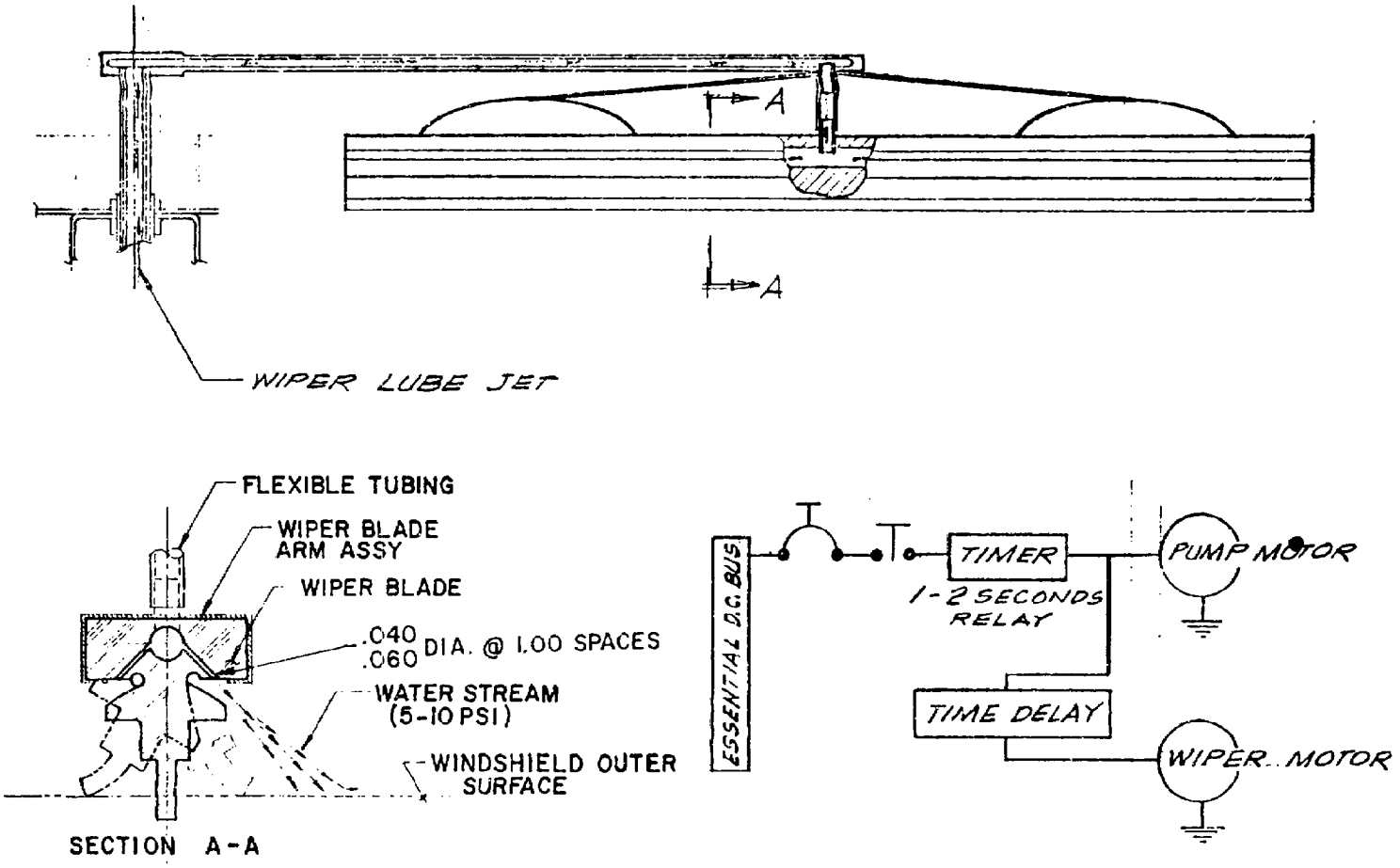


Figure 36. "Lube Blade" Windshield Wiper Concept

The "lube blade" washer system consists of a pump, reservoir, and wiper blades with built-in spray nozzles as depicted in figure 36. The system is operated by a switch. When the switch is placed to the ON position, power is applied to the wiper arm, and simultaneously to the wash fluid pump. After a 1-second time delay, the wiper arm automatically begins to operate. When sufficient wiping is accomplished after three to four cycles, the dispersion of wash fluid is stopped. If further washing is desired, the wash system can be manually engaged.

The modification to the existing wash system for incorporating the lube system concept will result in approximately 5 pounds weight increase. (See figure 37.)

Cost Analysis

The annual savings in the cost of replacing damaged windshields and by incorporating the wiper system modification is estimated to be $20,900. This is based on a cost trade analysis (refer to table 10) developed for a 10-year life cycle costing.

OPTION 4 - "LUBE BLADE" WINDSHIELD WIPER

Item	Existing design	Proposed design	Weight penalty
Wiper blade instl	1.7	1.7	-
Wiper motor instl	2.5	2.5	-
Pump	2.2	2.2	-
Container	1.1	1.3	0.2
Water	12.5	16.7	4.2
Other tubing supports	0.4	0.4	-
Total system	(20.4)	(24.8)	(4.4)

NOTE: All weights in pounds.

Figure 37 - CH-53 Windshield Wiper and Frame Weight Data.

TABLE 10. COST ANALYSIS

CH-53 TRANSPARENCY SYSTEM

OPTION 4 - "LUBE BLADE" WINDSHIELD WIPER

Summary

Present Concept	
Field Maintenance	$ 72,861
Spares	385,913
Total F/M and spares - 10-year LCC	$458,774
Redesign Concept	
Redesign and development	$ 12,555
Kit installation	27,550
Field Maintenance	11,417
Spares	197,595
Total F/M, spares and nonrecurring and recurring R&D - 10-year LCC	$249,117
10-year LCC savings	$209,657
Annual (average) savings	$ 20,900

TABLE 10. COST ANALYSIS (Continued)

CH-53 TRANSPARENCY SYSTEM

OPTION 4 - "LUBE BLADE" WINDSHIELD WIPER

Present Concept

Field Maintenance

WUC partial 1111B and 1111C (See Option 1, page 97)	$ 5,223
F/M cost = 0.35(8,036 + 6,888) = $5,223	
Total years	10
Escalation factor 1978-1983	1.395 (27)
Total cost 10 years	$ 79,906

Spares

WUC partial 1111B and 1111C (See Option 1, page 97)	$ 27,664
Spare cost = 0.35(47,360 + 31,680) = $27,664	
Total years	10
Escalation factor	1.395
Total cost 10 years	$385,913

(27) Escalation factors (reference 6)

TABLE 10. COST ANALYSIS (Continued)

CH-53 TRANSPARENCY SYSTEM

OPTION 4 - "LUBE BLADE" WINDSHIELD WIPER

Redesign Concept - Nonrecurring

Tooling - No effort required.

Engineering

Design	132	
TCTO	44	
Total engineering labor	176	
Engineering labor rate	$40	
Engineering labor dollars	$7,040	
Engineering material	15	
Total engineering	$7,055	$7,055

Certification

Engineering: by comparison to similar parts	$1,500	
Kits and material	800	
Test	3,200	
Total certification/W/S wiper blade	$5,500	$ 5,500
Total nonrecurring cost		$12,555

TABLE 10. COST ANALYSIS (Continued)

CH-53 TRANSPARENCY SYSTEM

OPTION 4 - "LUBE BLADE" WINDSHIELD WIPER

Redesign Concept - Recurring Cost

Field Maintenance

Total WUC attributed How-Mal dirt-cont, crazed, scratched, and scored = (0.35 x 635) = 222[28] hr at $14/hr =	$ 3,108
Service improvement $3,108 x 70% =	-2,176
Remaining F/M due to How-Mal	$ 932
Total years	10
	$ 9,320
Escalation factor	1.225
	$11,417

Spares Replacement

	LH	RH
No. of spares	32	22
R/R due to How-Mals (ref MAM's)	0.35	0.35
	11.2	7.7
Less adjustment for extended service life of 40%	0.4	0.4
	4.5	3.1
Revised unit cost[1]	$ 2,146	$2,088
	$9,657	$6,473

Total projected spares = $9,657 + $6,473 =	$ 16,130
Total years	10
	$161,300
Escalation factor 1978-1983	1.225
Total spares cost	$197,595

(1) Revised unit cost

	LH	RH
Current cost	$1,480	$1,440
45% of current cost	666	648
	$2,146	$2,088

Redesigned windshield "lube blade" wiper system

Estimated cost of kit $474 x 50[29] =	$23,700
Estimated installation time $77 x 50 =	3,800
	$27,550

(28) Maintenance hours attributed to SDCC denotes How-Mal's - scored, scratched, delaminated, crazed, cracked, etc.

(29) 50 aircraft in fleet.

TABLE 10. COST ANALYSIS (Continued)

CH-53 TRANSPARENCY SYSTEM

OPTION 4 - "LOBE BLADE" WINDSHIELD WIPER

Engineering Hours Estimate

Design study materials, establish basic design, adapt to two-window installation	24
Vendor coordination	20
Establish and release 1 blade configuration	20
Establish and release 1 W/S wiper installation	16
Miscellaneous changes - design maintenance	8
Subtotal	88
Stress	24
Checking	10
Materials and processing	4
Project office	4
Release	2
Subtotal	44
Total Engineering	132

TABLE 10. COST ANALYSIS (Continued)

CH-53 TRANSPARENCY SYSTEM

OPTION 4 - "LUBE BLADE" WINDSHIELD WIPER

Technical Order Support

TCTO:	Authorize field modification to aircraft	12 hours
	Kit proof and changes	2 hours
		14 hours

Flight Manual

T.O.: Airframe maintenance

Add data to describe, install and maintain new installation

T.O. revisions	13 hours
Material cost	$5

T.O.: Illustrated parts breakdown, add changed data to parts list

T.O. revisions	10 hours
Material cost	$4

T.O.: Numerical Index added change data

T.O. revisions	7 hours
Material cost	$6

Total labor hours	44 hours
Cost	$15

This estimate is based on input obtained from transparency design and technical support functions.

TABLE 10. COST ANALYSIS (Concluded)

CH-53 TRANSPARENCY SYSTEM

OPTION 4 - "LUBE BLADE" WINDSHIELD WIPER

Windshield Wiper Estimated Costs

Component Cost

Converter assembly	175.00	2	350.00
Arm assembly	25.00	2	50.00
Blade flex (lube)	18.00	2	36.00
Time delay switch	37.50	1	37.50
Kit total			$473.50

Installation Cost

	Remove and Install
Converter assembly	1.50 x 2 = 3.0
Assembly arm drive	0.50 x 2 = 1.0
Blade flex	0.25 x 2 = 0.5
Time delay switch	1.00 x 1 = 1.0
	5.5 hours
F/M rate at $14/hour	$77

SECTION VII

CH-3 TRANSPARENCY SYSTEM DESIGN IMPROVEMENT TRADE STUDY

CONFIGURATION DESCRIPTION

The CH-3 transparency configuration for the crew compartment is similar to the CH-53. The transparencies include a three-segment windshield, four forward and side viewing windows, and five observation windows (see figure 38). The windshields are a laminated two-ply acrylic with a vinyl interlayer including heating provisions. The remaining crew compartment windows are monolithic (single ply) acrylic.

FAILURE ANALYSIS

As was the case on the CH-53, the most serious problem in maintaining the CH-3 transparencies is the excessive abrasions and scratches attributed to the windshield wiper. Field-level maintenance personnel state that scratching, crazing, and cracking contribute in excess of 50 percent of the effort and costs for these windshield assemblies. A considerable amount of the abrasions is caused by improper cleaning and ground-handling procedures, environmental and weathering factors. Some delamination is caused by windshield heaters.

The description of the failures as diagramed in the fault trees, figures 39 and 40, was assembled from the MAM's program. Figures 41 and 42 present and summarize the more significant How-Mal's, actions taken, and probable cause of failure. The failure mode descriptors in combination with flight hours, maintenance hours, and logistical cost are contained in the sampling MAM's tabulation shown in figure A-5 of Appendix A.

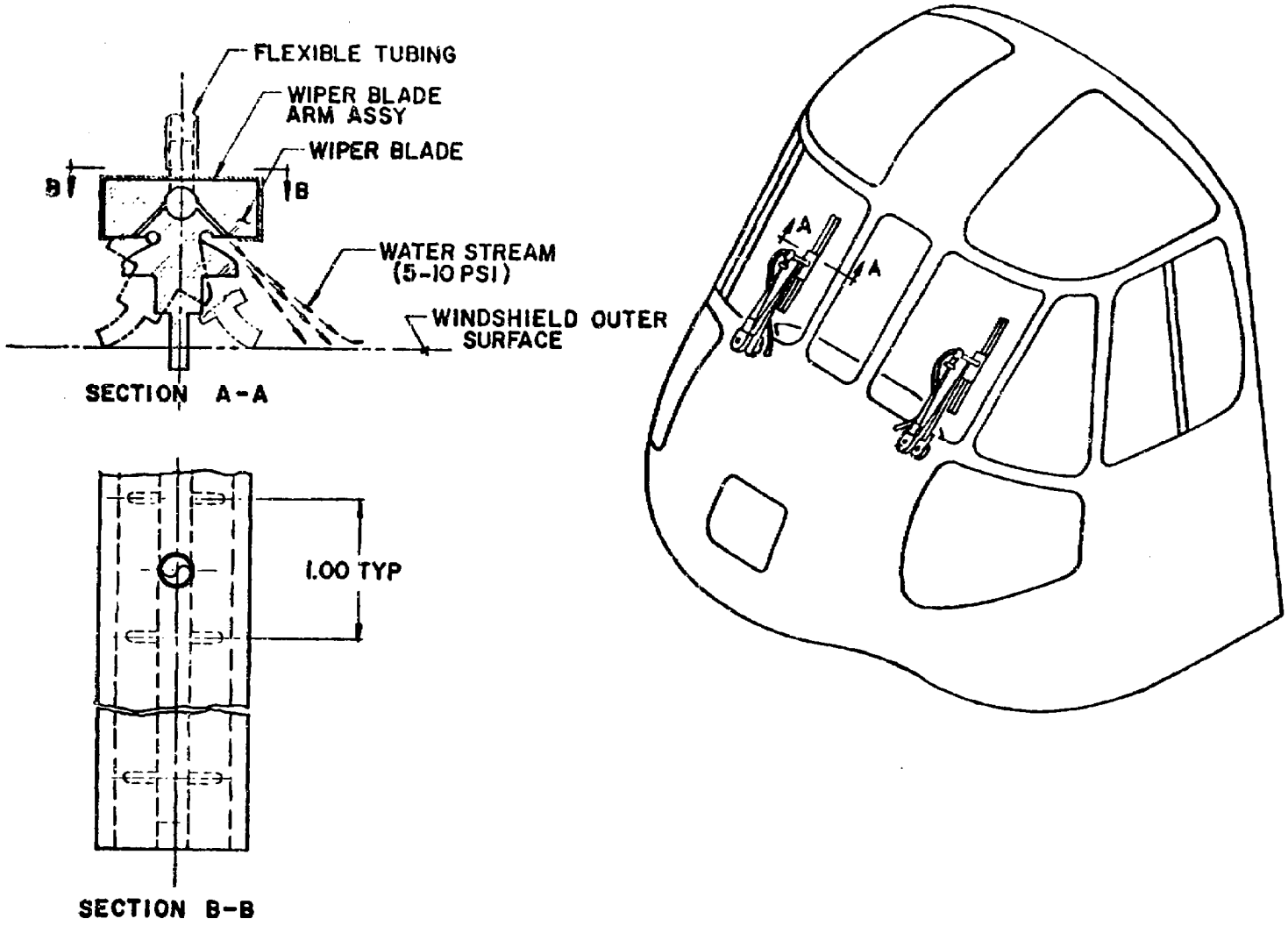


Figure 38. Cl-3 Windshield and Cabin Window Configuration

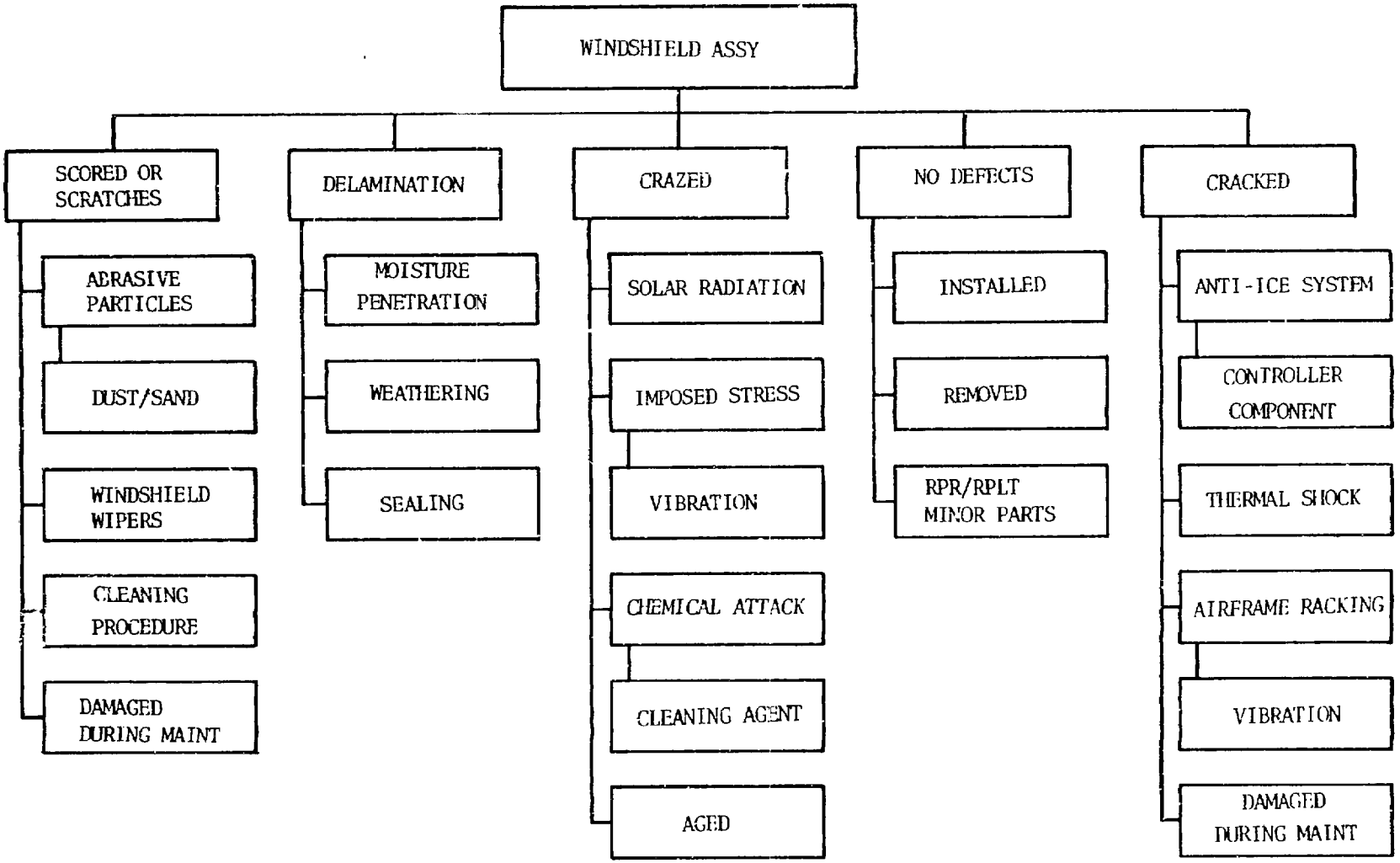


Figure 39. Fault Tree CH-3 Windshield Assembly

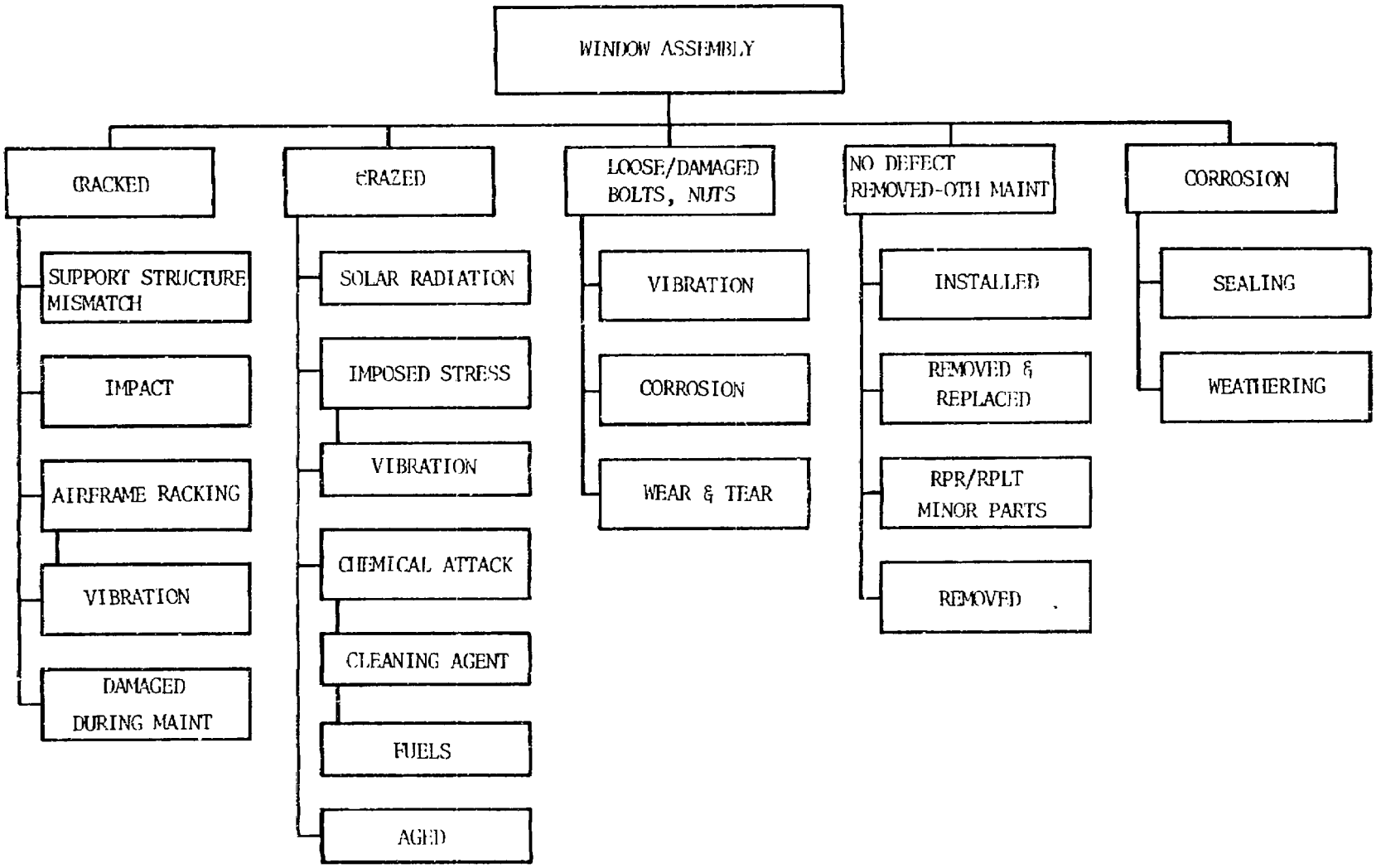


Figure 40. Fault Tree CH-3 Window Assembly

IIIIE WINDSHIELD

HOW MAL	ACTION TAKEN	PROBABLE CAUSE
935 SCORED OR SCRATCHES	R - REMOVE AND REPLACE G - REPAIR/REPLACEMENT MINOR PARTS F - REPAIR	° WINDSHIELD WIPERS ° IMPROPER CARE ° DAMAGED DURING MAINT.
846 DELAMINATION	R - REMOVE AND REPLACE G - REPAIR/REPLACEMENT MINOR PARTS	° SEALING ° WEATHERING
605 CRAZED	R - REMOVE AND REPLACE P - REMOVED G - REPAIR/REPLACEMENT MINOR PARTS	° SOLAR RADIATION ° IMPOSED STRESS ° CHEMICAL ATTACK
799 NO DEFECTS	Q - INSTALLED P - REMOVED G - RPR/RPCT MINOR PARTS	° INTERRELATED WITH OTHER HOW MAL CODES
190 CRACKED	G - REPAIR/REPLACEMENT MINOR PARTS R - REMOVE AND REPLACE	° ANTI-ICE SYSTEM ° THERMAL SHOCK ° AIRFRAME RACKING

Figure 41. CH-3 Windshield Assembly Failure Analysis Summary

IIIII WINDOW

	HOW MAL	ACTION TAKEN	PROBABLE CAUSE
190	CRACKED	G - REPAIR/REPLACEMENT MINOR PARTS A - BENCH CHECK AND REPAIRED F - REPAIR	° IMPACT ° AIRFRAME RACKING
605	CRAZED	R - REMOVED AND REPLACED	° SOLAR RADIATION ° IMPOSED STRESS ° CHEMICAL ATTACK
105	LOOSE/DAMAGED BOLTS	G - REPAIR/REPLACEMENT MINOR PARTS P - REMOVED	° VIBRATION ° CORROSION ° WEAR AND TEAR
800	NO DEFECTS REMOVED - OTH MANT	Q - INSTALLED S - REMOVE AND REINSTALL P - REMOVED	° INTERRELATED WITH OTHER HOW MAL CODES
170	CORROSION-MILD/ MODERATE	Z - CORROSION REPAIR G - REPAIR/REPLACEMENT MINOR PARTS	° SEALING ° WEATHERING

Figure 42. Fault Tree CH-3 Window Assembly Failure Analysis Summary

CANDIDATE DESIGN IMPROVEMENTS

After examination of the failure analysis data and results it was concluded that the following candidate improvements should be considered and investigated.

1. Incorporate glass outer ply and PPG-liner material layer bonded to the inner ply of acrylic for pilot's and copilot's windshields for improved abrasion resistance.

2. Incorporate two-ply PPG-liner material bonded to the inner and outer surfaces of the center windshield for improved abrasion resistance.

3. Incorporate improved windshield frame for improved sealing.

4. Incorporate PPG-liner material bonded to the inner and outer surfaces of cabin windows for improved abrasion resistance.

5. Incorporate "lube blade" windshield wiper.

INVESTIGATION AND RATIONALE FOR SELECTED CANDIDATES

The investigation of the candidates and the rationale developed to select the potential options are the same as those shown in Section VI, pages 86 through 88.

SELECTED TRADE STUDIES

Based on the cost analysis as contained in this section, the following candidates are recommended for implementation. These design improvements are presented as "options" for the incorporation of one or more features designed to reduce logistical support costs.

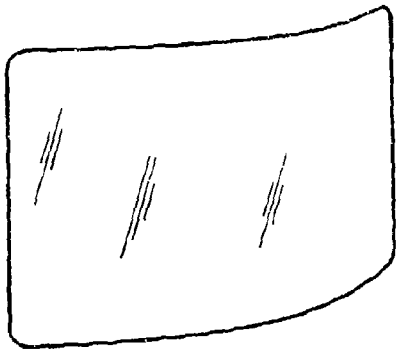
The analysis of Options 1, 2, and 3 was performed in combination because data required to separate was not available. It should be noted, however, that Option 4 should not be added to 1, 2, and 3 because they have varying impact on common maintenance effort and/or spare parts.

PROPOSED CHANGE OPTIONS

OPTION 1 (CANDIDATE 1 - GLASS AND PPG-LINER MATERIAL FOR PILOT'S AND COPILOT'S WINDSHIELDS)

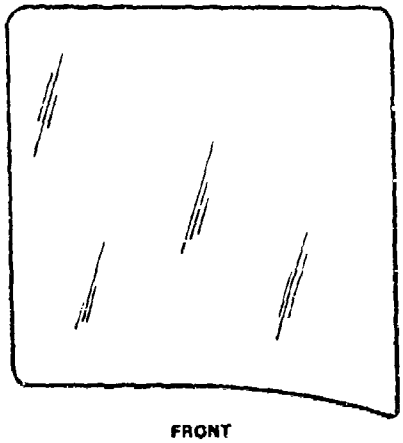
The proposed change to significantly reduce or eliminate the scratching and abrasion problems is to incorporate a multilaminate glass, acrylic, and PPG-liner material configuration for the pilot's and copilot's windshield assemblies. The existing design consists of an inner and outer ply of stretched acrylic with a PVB interlayer as shown in figure 43. The proposed design (see figure 44) is also configured as a multilaminate construction. The outer ply is 0.050-inch Chemcor glass to provide protection against scratching and spalling. For improved resistance to cold chipping, a PPG 112 interlayer (0.057-inch) is recommended. The remaining plies consist of an outer layer of 0.020-inch PPG-liner material bonded to a 0.150-inch stretched acrylic structural ply.

The liner material being considered for this application is currently being developed by PPG Industries. The new liner material will significantly improve the abrasion resistance of current plastic glazing materials. This new liner can be applied to the inboard and outboard surfaces of glass, acrylic, and polycarbonate glazing materials. Based on PPG estimates, use of this liner on the inboard surfaces of the center, pilot's, and copilot's windshields should increase the life of those panels by a factor of 3 to 4. Glass spall sheets are recommended for the outboard surfaces of the pilot's and copilot's windshields to increase service life of those panels subjected to windshield wiper operation.

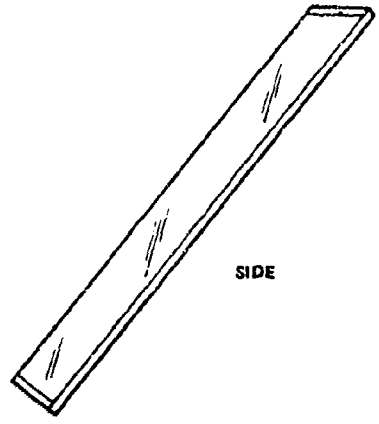


PLAN

S6120-61228-1, -2, -3 OR -4
TWO PLIES 0.125 IN. GLASS WITH 0.080 IN. INTERLAYER PER MIL-G-25871 (HEATED WINDSHIELD)
S6122-87171-1 OR -2
0.060 IN. CR-39 FACE PLY, 0.075 IN. INTERLAYER AND 0.150 IN. ACRYLIC, MIL-P-25690 INNER PLY (UNHEATED)
S6122-87172-1 AND -2
0.060 IN. FACE PLY SIERRACIN 900 OR CR-39, 0.075 IN. INTERLAYER, 0.150 IN. ACRYLIC, MIL-P-25690 INNER PLY (HEATED)



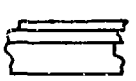
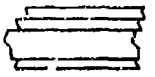
FRONT



SIDE

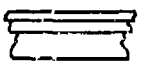
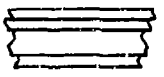
Figure 43. CH-3, Pilot's and Copilot's Windshield Panels

OPTION 1 - GLASS AND PPG-LINER MATERIAL FOR PILOT'S AND COPILOT'S WINDSHIELDS

Item	Area ($in.^2$/AV)	Existing design		Proposed design		Weight penalty (lb)
		Config & thickness (in.)	Wt (lb)	Config & thickness (in.)	Wt (lb)	
Windshield (pilot/copilot)	1,588	 0.062 S-900 0.075 PVB 0.150 S/A	19.5	 0.050 Chemcor 0.057 I/L 0.150 S/A 0.020 PPG-LM	22.2	2.7

S/A = stretched acrylic I/L = interlayer PPG-LM = PPG urethane liner material
PVB = poly vinyl butyral AV = air vehicle

OPTION 2 - STRETCHED ACRYLIC AND PPG LINER MATERIAL FOR CENTER WINDSHIELD

Item	Area ($in.^2$/AV)	Existing design		Proposed design		Weight penalty (lb)
		Config & thickness (in.)	Wt (lb)	Config & thickness (in.)	Wt (lb)	
Center windshield	418	 0.062 S-900 0.075 PVB 0.150 S/A	5.1	 0.062 PPG-LM 0.055 I/L 0.150 S/A 0.020 PPG-LM	5.0	-

OPTION 3 - WINDSHIELD FRAME MODIFICATION FOR IMPROVED SEALING

Weight increase considered negligible

OPTION 4 - LUBE BLADE WINDSHIELD WIPER (See CH-53.)

Weight increase 4.4 lb

Figure 44. CH-5 Transparency Design Data

OPTION 2 (CANDIDATE 2 - STRETCHED ACRYLIC AND PPG-LINER MATERIAL FOR CENTER WINDSHIELD)

The center windshield panel is also subject to excessive scoring and scratching due to ground handling and cleaning procedures and to environmental factors. It is therefore proposed that a multilaminate containing two plies of PPG-liner material with an improved PPG-112 interlayer (0.055-inch) be substituted for the existing PVB interlayer. The proposed configuration will consist of a 0.062-inch PPG-liner material outer ply, the PPG-112 interlayer, and a 0.020-inch outer layer of PPG-liner material bonded to a 0.050-inch stretched acrylic structural ply. Figure 44 shows a comparison of the existing design and the proposed design. The principal advantage of the proposed configuration is significant increase in abrasion resistance for negligible weight change.

OPTION 3 (CANDIDATE 3 - WINDSHIELD FRAME MODIFICATION FOR IMPROVED SEALING)

Data from both field audits of operation level and from the AFM 66-1 MDC system indicates that 35 percent of windshield failures that are attributed to delaminations, cracking, etc, are due to moisture penetration. A secondary effect is the onset of corrosion, especially for those helicopters operating in the coastal areas. In order to substantially reduce this problem, it is proposed that the framing and support modification as shown on figure 33 of Section VI be incorporated. The principal modification to accomplish this change is a seal plate that is affixed to the juncture of the windshield column and windshield panel edge member.

Cost Analysis

The annual savings for incorporating Options 1, 2, and 3 is $48,900. The basis for this analysis is a 10-year life cycle cost projection (refer to table 11). The source of maintenance hours, numbers of spares, unit cost was developed using AFM 66-1 data base and the data collected from Warner Robins ALC (October 1977), and the most recent from the 302-SOS, Luke AFB (April 1979).

TABLE 11. COST ANALYSIS

CH-3 TRANSPARENCY SYSTEMS

OPTION 1 - GLASS AND PPG-LINER MATERIAL FOR PILOT'S AND COPILOT'S WINDSHIELDS
2 - STRETCHED ACRYLIC AND PPG-LINER MATERIAL FOR CENTER WINDSHIELD
3 - WINDSHIELD FRAME MODIFICATION FOR IMPROVED SEALING

Summary

Present Concept	
Field Maintenance	$ 213,864
Spares	808,500
Total F/M and spares - 10-year LCC	$1,022,364
Redesign Concept	
Redesign and development	$ 48,175
Field Maintenance	126,818
Spares	358,313
Total R&D F/M and spares - 10-year LCC	$533,306
10-year LCC savings	$489,058
Annual (average) savings	$ 48,900

TABLE 11. COST ANALYSIS (Continued)

CH-3 TRANSPARENCY SYSTEMS

OPTION 1 - GLASS AND PPG-LINER MATERIAL FOR PILOT'S AND COPILOT'S WINDSHIELDS
2 - STRETCHED ACRYLIC AND PPG-LINER MATERIAL FOR CENTER WINDSHIELD
3 - WINDSHIELD FRAME MODIFICATION FOR IMPROVED SEALING

Present Concept

Field maintenance annual cost

Windshield WUC	DDCC Maintenance Hours/Year	LSC/Year
1111E(30)	1,140 hr x $14.00/hr(31)	$ 15,960

10-year LCC factor	10
Escalation factor 1976-1983	1.340(32)
Total 10-year LCC windshield field maintenance	$213,864

Spares

January 1976 through October 1976

WUC 1111E	Removed and replaced	19
	Installed	1
	Total spares	20

Total/annual 20/10 x 12 = 24 x 1.826 = 44 spares
(1.826 fleet adjustment factor)

44 spares at $1,500 =	$ 66,000	annual
10-year LCC factor	10	
Escalation factor 1978-1983	1.225(32)	
Total 10-year LCC windshield spares	$808,500	

(30) Includes pilot's, copilot's, and center windshield assemblies.

(31) Field maintenance rate, incl direct labor, G&A, and overhead

(32) Escalation factors (reference 6)

TABLE 11. COST ANALYSIS (Continued)

CH-3 TRANSPARENCY SYSTEMS

OPTION 1 - GLASS AND PPG-LINER MATERIAL FOR PILOT'S AND COPILOT'S WINDSHIELDS
2 - STRETCHED ACRYLIC AND PPG-LINER MATERIAL FOR CENTER WINDSHIELD
3 - WINDSHIELD FRAME MODIFICATION FOR IMPROVED SEALING

Nonrecurring Cost

Tooling - No effort required.

Engineering

Design		250
TCTO		200
Total engineering labor		450
Engineering labor rate		40/hr
Engineering labor dollars		$18,000
Engineering material dollars		175
Total engineering		$18,175
Certification:		
Engineering		$ 750
Testing		$7,500
Panel fabrication (3 each)		
Current panel cost	1,500	
(Added effort 50% of current)	750	
	$2,250 x 3	6,750
Total test per certification		$15,000
Two configurations		2
Total certification		$30,000
TOTAL NONRECURRING COST $30,000 + $18,175 =		$48,175

TABLE 11. COST ANALYSIS (Continued)

CH-3 TRANSPARENCY SYSTEMS

OPTION 1 - GLASS AND PPG-LINER MATERIAL FOR PILOT'S AND COPILOT'S WINDSHIELDS

Redesign Concept - Recurring Cost

Field Maintenance (F/M)

Total attributed to other than DSSC 562 hr at $14.00 =		$ 7,868
Total attributed to DSSC 380 hr at $14.00 =	$5,320	
Less service life improvement at 70% x $5,320 =	3,724	
F/M attributed to DSSC	$1,596	$ 1,596
Annual F/M for revised concept		9,464
Total years		10
Escalation factor 1976-1983		1.340
Total 10-year field maintenance redesign concept		$126,818

Spares

Projected spares current annual WUC requirement		44	
WUC spares attributed to 70% extension of service life		13	
Current spares value	$1,500[33]		
Added effort 50%[34] of current cost	$2,250	x 13 =	$ 29,250
Total years			10
Escalation factor 1978-1983			1.225
Total 10-year spares for redesigned concept			$358,313

(33) "H-3 Spare Cost Data", from 302/SOS/MA Luke AF Base

(34) Service life factor for PPG-liner material

TABLE 11. COST ANALYSIS (Concluded)

CH-3 TRANSPARENCY SYSTEMS

MAINTENANCE DATA FROM 302/SOS/MA LUKE AIR FORCE BASE

Aircraft type	CH-3 helicopter
Aircraft at location	7 aircraft
Windshield replacement Jan 78 through Jan 79 (13 mo)	10 units
Average monthly replacement 10 units/13 months	0.769 unit per month
Total approximate cost	$15,000
Average approximate cost/unit	$1,500
Average monthly approximate spares cost $1,500 x 0.769 =	$1,154/month

OPTION 4 (CANDIDATE 5 - "LUBE BLADE" WINDSHIELD WIPER)

Field maintenance personnel that are very knowledgeable state that most of the damage to the windshield occurs during the initial wiping action. Much of this damage is caused by fine layers of dust and grime that collect on the windshield. In the case of the CH-3 wiper system, the wash fluid system can be activated, and 2 seconds later the wiper arm starts its wiping action. The spray from a "spray tube" (figure 38) is applied in a dispersed pattern. The spray pattern from the manifold does not provide uniform saturation of the wiped surface. Consequently, scratching of the windshield, especially from wiper blades that harden from age, results.

It is therefore proposed that the "lube blade" concept as shown in figure 38 be incorporated as means of eliminating this problem. The principle utilized by the "lube blade" is dispersal of the wash fluid, through a jet stream, providing a uniform coverage across the full length of the wiper blade. The wash fluid is dispersed at the wiper blade wiping tip, as shown in figure 38. The fluid is pumped into a tubular manifold and dispersed through jet ports approximately 1 inch apart. The lower part of the wiper blade is formed to act as a valve, blocking off the jets on the retreating side of the blade and concentrating all the flow to the advancing side of the wiper blade. The concentration of the wash fluid at the "tip" point of contact will lubricate the surface and prevent scratching of the windshield surface.

The "lube blade" washer system consists of a pump, reservoir, and wiper blades with built-in spray nozzles as depicted in figure 35, Section VI. The system is operated by a switch. When the switch is placed to the ON position, power is applied to the wiper arm, and simultaneously to the wash fluid pump. After a 1-second time delay, the wiper arm automatically begins to operate. When sufficient wiping is accomplished after three to four cycles, the dispersion of wash fluid is stopped. If further washing is desired, the wash system can be manually engaged.

The modification to the existing wash system for incorporating the lube system concept will result in approximately 5 pounds weight increase. (See figure 37, Section VI.)

Cost Analysis

The annual savings in the cost of replacing damaged windshields and by incorporating the wiper system modification is estimated to be $23,300. This is based on a cost trade analysis (refer to table 12) developed for a 10-year life cycle costing.

TABLE 12. COST ANALYSIS

CH-3 TRANSPARENCY SYSTEM

OPTION 4 - "LUBE BLADE" WINDSHIELD WIPER

Summary

Present Concept	
Field Maintenance	$ 90,815
Spares	$460,350
Total F/M and spares - 10-year LCC	$551,165
Redesign Concept	
Redesign and development	$12,555
Kit installation	49,590
Field Maintenance	23,924
Spares	231,794
Total F/M, spares and nonrecurring and recurring R&D - 10-year LCC	$317,863
10-year LCC savings	$233,302
Annual (average) savings	$ 23,300

TABLE 12. COST ANALYSIS (Continued)

CH-3 TRANSPARENCY SYSTEM

OPTION 4 - "LUBE BLADE" WINDSHIELD WIPER

Present Concept

Field Maintenance

WUC-DSS[35] 387.7/10 x 12 = 465 hr at $14/hr[36]	$ 6,510
Total years	10
Escalation factor 1976-1983	1.395[37]
Total cost 10 years	$90,815

Spares

MAM 1/76-10/76	
WUC-DSS 18/10 x 12 = 22	
22 spares at $1,500 =	$ 33,000
Total years	10
Escalation factor 1976-1983	1.395
Total cost 10 years	$460,350

(35) Maintenance hours attributed to dirt-cont, scored and scratched

(36) Field maintenance rate, incl direct labor, G&A, and overhead

(37) Escalation factors (reference 6)

TABLE 12. COST ANALYSIS (Continued)

CH-3 TRANSPARENCY SYSTEM

OPTION 4 - "LUBE BLADE" WINDSHIELD WIPER

Redesign Concept - Nonrecurring

Tooling - No effort required.

Engineering

Design	132	
TCTO	44	
Total engineering labor	176	
Engineering labor rate	$40	
Engineering labor dollars	$7,040	$7,040
Engineering material		15
Total engineering		$7,055

Certification

Engineering: by comparison to similar parts	$1,500	
Kits and material	$ 800	
Test	$3,200	
Total certification W/S wiper blade		$ 5,500
Total nonrecurring cost		$12,555

TABLE 12. COST ANALYSIS (Continued)

CH-3 TRANSPARENCY SYSTEM

OPTION 4 - "LUBE BLADE" WINDSHIELD WIPER

Recurring Cost

Field Maintenance

Total WUC attributed How-Mal dirt-cont, scratched, and scored = 465 hr at $14/hr =	$6,510	
Service improvement 70% x 6,510 =	$4,557	
Remaining F/M due to How-Mal	$1,953	$ 1,953
Total years		10
Escalation factor 1978-1983		1.225
Total 10-year field maintenance		$23,924

Spares Replacement

Windshield	59
R/R due to How-Mal (ref MAM's)	0.37
	21.8
Less adjustment for extended service life of 40%	0.4
	8.7
Revised unit cost = $1,500(1 + 45%) =	$ 2,175
	$18,922
Total years	10
	$189,220
Escalation factor 1978-1983	1.225
Total 10-year spares	$231,794

Redesigned Windshield Lube Blade Wiper System

Estimated cost of kit	$474 x 90[38] =	$42,660
Estimated installation time	$77 x 90 =	6,930
		$49,590

(38) 90 aircraft in fleet

TABLE 12. COST ANALYSIS (Continued)

CH-3 TRANSPARENCY SYSTEM

OPTION 4 - "LUBE BLADE" WINDSHIELD WIPER

Engineering Hours Estimate

Design study materials, establish basic design, adapt to two-window installation	24
Vendor coordination	20
Establish and release 1 blade configuration	20
Establish and release 1 W/S wiper installation	16
Miscellaneous changes - design maintenance	8
Subtotal	88
Stress	24
Checking	10
Materials and processing	4
Project office	4
Release	2
Subtotal	44
Total Engineering	132

TABLE 12. COST ANALYSIS (Continued)

CH-3 TRANSPARENCY SYSTEM

OPTION 4 - "LUBE BLADE" WINDSHIELD WIPER

Technical Order Support

TCTO:	Authorize field modification to aircraft	12 hours
	Kit proof and changes	2 hours
		14 hours

Flight Manual

T.O.: Airframe maintenance

Add data to describe, install and maintain new installation

T.O. revisions	13 hours
Material cost	$5

T.O.: Illustrated parts breakdown, add changed data to parts list

T.O. revisions	10 hours
Material cost	$4

T.O.: Numerical Index added change data

T.O. revisions	7 hours
Material cost	$6

Total labor hours	44 hours
Cost	$15

This estimate is based on input obtained from transparency design and technical support functions.

TABLE 12. COST ANALYSIS (Concluded)

CH-3 TRANSPARENCY SYSTEM

OPTION 4 - "LUBE BLADE" WINDSHIELD WIPER

Component Cost

Converter assembly	175.00	2	350.00
Arm assembly	25.00	2	50.00
Blade flex (lube)	18.00	2	36.00
Time delay switch	37.50	1	37.50
Kit total			$473.50

Installation Cost

	Remove and Install
Converter assembly	1.50 x 2 = 3.0
Assembly arm drive	0.50 x 2 = 1.0
Blade flex	0.25 x 2 = 0.5
Time delay switch	1.00 x 1 = 1.0
	5.5 hours
F/M rate at $14/hour	$77

SECTION VIII

UH-1F AND P TRANSPARENCY SYSTEM DESIGN IMPROVEMENT TRADE STUDY

CONFIGURATION DESCRIPTION

The UH-1 series crew compartment transparencies includes a windshield for the pilot and copilot, four side viewing windows, and four observation windows. The two windshields (figure 45) as well as the side viewing and observation windows are monolithic (single ply) acrylic panels. The two windshields are defogged by a hot air system and contain a windshield wiper for each panel.

FAILURE ANALYSIS

Examination of the AFM 66-1 MDC data as well as the maintenance data requested from Warner Robins ALC (reference 11) indicated that the majority of the transparencies were replaced because of the breakage, cracks, and scratches. The main cause of the scratches is associated with the windshield wipers. It takes approximately 6 to 8 psi of pressure (approximately 12 to 15 pounds of force) to wipe properly. This pressure abrading against grimy and dirty surfaces is the principal cause for scratching.

The description of these failures as diagramed in the fault trees, figures 46 and 47, was assembled from the MAM's program. Figures 48 and 49 present and summarize the more significant How-Mal's, action taken, and probable cause of failure. The failure mode descriptors in combination with flight hours, maintenance hours, and logistical cost are contained in the sampling MAM's tabulation shown in figure A-6 of Appendix A.

Reference 11. William J. Coleman, Major, USAF, "Acquisition of Logistical Support and Cost Data for the UH-1F/P Windshield and Window System (Ref 79LA-0232 Ltr, 26 Mar 79)", AFLC Letter WR-ALC/MMSRCA, Headquarters Warner Robins Air Logistics Center (AFLC), Robins Air Force Base, Georgia 31098, 6 April 1979.

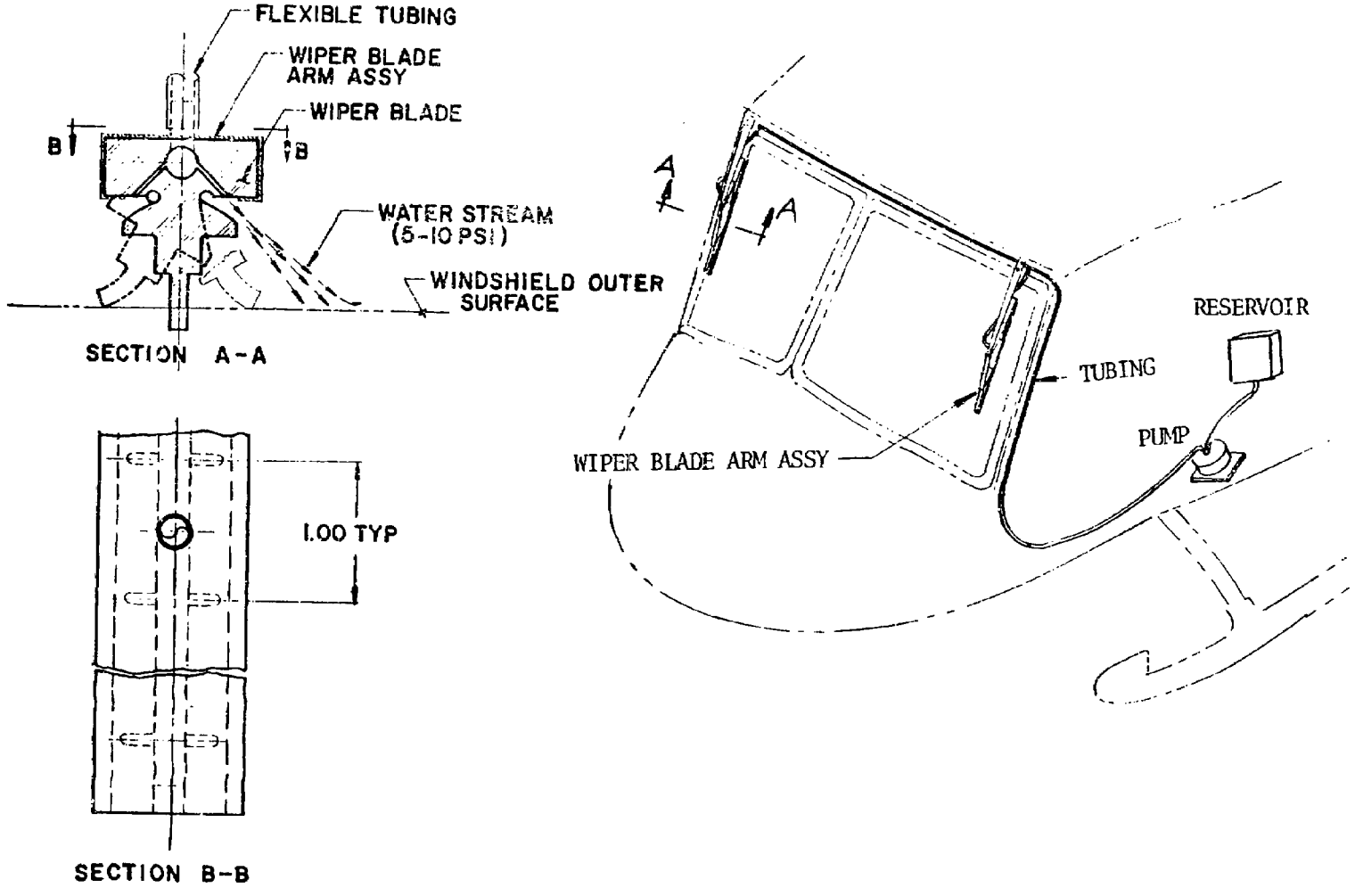


Figure 45. UH-1F/P Windshield and Cabin Window Configuration

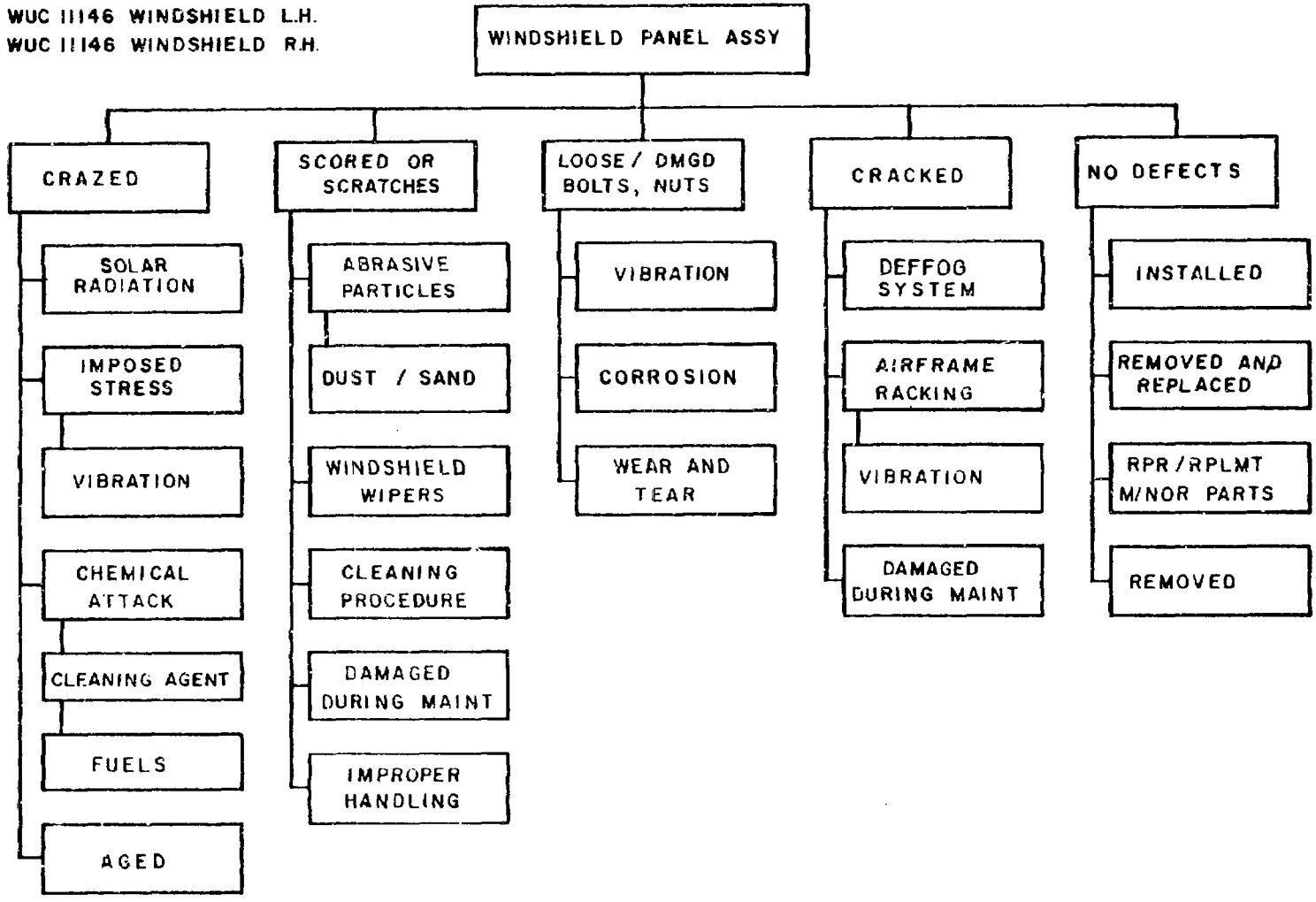


Figure 46. Fault Tree UH-1/P Windshield Panel Assemblies

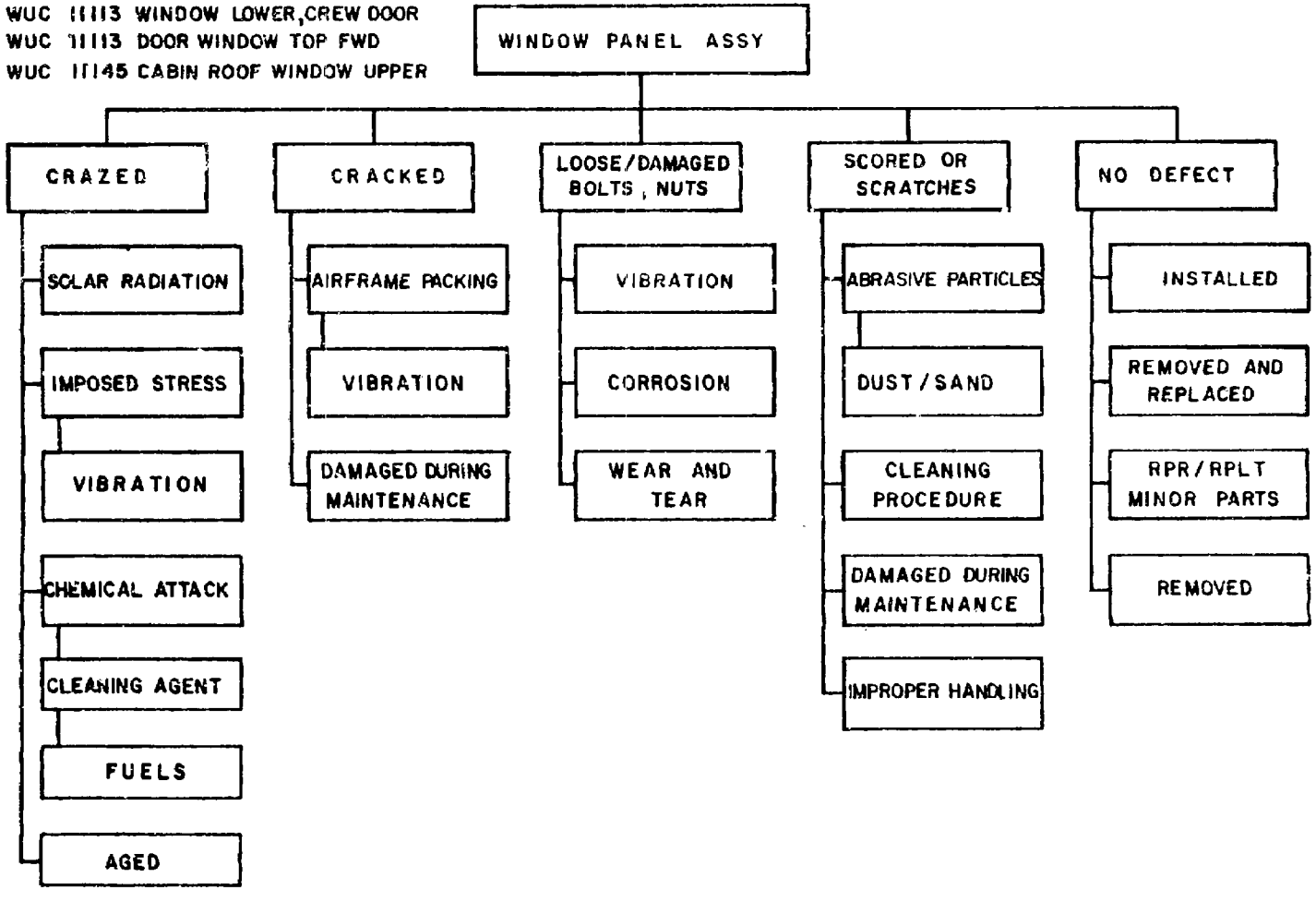


Figure 47. Fault Tree UH-1F/P Window Assemblies

WUC 11146 WINDSHIELD L.H.
WUC 11146 WINDSHIELD R.H.

HOW MAL	ACTION TAKEN	PROBABLE CAUSE
605 - CRAZED	R - REMOVE AND REPLACE P - REMOVED G - RPR/RPLT MINOR PARTS Q - INSTALLED	*SOLAR RADIATION *IMPOSED STRESS *CHEMICAL ATTACK *AGED
935 - SCORED OR SCRATCHES	R - REMOVE AND REPLACE G - RPR/RPLT MINOR PARTS V - CLEAN P - REMOVED	*WINDSHIELD WIPERS *DAMAGED DURING MAINTENANCE *IMPROPER HANDLING
105 - LOOSE/DMGD BOLTS, NUTS	G - RPR/RPLT MINOR PARTS	*VIBRATION *CORROSION *WEAR AND TEAR
799 - NO DEFECTS	Q - INSTALLED R - REMOVE AND REPLACE X - TEST-INSPECT-SERVICE G - RPR/RPLT MINOR PARTS R - REMOVE AND REPLACE	*INTERRELATED WITH OTHER HOW MAL CODES *ANTI-ICE SYSTEM *AIRFRAME RACKING

Figure 48. UH-1F/P Windshield Assembly Failure Analysis Summary

WUC 11113 WINDOW, LOWER, CREW DOOR L.H.
WUC 11145 CABIN ROOF WINDOW UPPER L.H.
WUC 11113 DOOR WINDOW TOP FWD L.H.

WUC 11113 WINDOW, LOWER, CREW DOOR R.H.
WUC 11145 CABIN ROOF WINDOW UPPER R.H.
WUC 11113 DOOR WINDOW TOP FWD R.H.

	HOW MAL	ACTION TAKEN	PROBABLE CAUSE
605 -	CRAZED	R - REMOVE AND REPLACE G - RPR/PRLT MINOR PARTS A - BENCH CHECK AND REPAIRED P - REMOVED	*SOLAR RADIATION *IMPOSED STRESS *CHEMICAL ATTACK
190 -	CRACKED	G - RPR/PRLT MINOR PARTS R - REMOVE AND REPLACE P - REMOVE X - TEST-INSPECT-SERVICE Q - INSTALLED	*AIRFRAME RACKING *DAMAGED DURING MAINTENANCE
105 -	LOOSE/DMGD BOLTS, NUTS	G - RPR/RPLT MINOR PARTS R - REMOVE AND REPLACE F - REPAIR L - ADJUST	*VIBRATION *CORROSION *WEAR AND TEAR
935 -	SCORED OR SCRATCHES	R - REMOVE AND REPLACE A - BENCH CHECK AND REPAIRED G - RPR/RPLT MINOR PARTS	* ABRASIVE PARTICLES *CLEANING PROCEDURE *DAMAGED DURING MAINTENANCE *IMPROPER HANDLING
799 -	NO DEFECTS	G - RPR/RPLT MINOR PARTS R - REMOVE AND REPLACE Q - INSTALLED X - TEST-INSPECT-SERVICE	*INTERRELATED WITH OTHER HOW-MAL CODES

Figure 49. UH-1F/P Window Assembly Failure Analysis Summary

CANDIDATE DESIGN IMPROVEMENTS

The first candidate to be selected was the consideration of a replacement glass windshield to counter the windshield wiper scratching problem. During the course developing the failure analysis, it was ascertained that the Army helicopter fleet was being retrofitted with glass windshields. These data were obtained from contacts specified in reference 11. Further investigation indicated that the UH-1 fleet originally had glass-type windshields and that, as a result of firing guns and rockets, minute pitting of the windshield due to envelopment of gas residue made it practically impossible to see through at certain conditions. For this reason, stretched acrylic plastic, resistant to the pitting, was substituted as replacement parts. Since the termination of the South Asia conflict, the requirement for carriage of armaments has been substantially reduced. It is estimated that approximately 200 aircraft, models UH-1, still retain armaments.

Since it appears desirable to retain the acrylic windshield for the 200 gun-firing UH-1 helicopters, it is therefore recommended that the "lube blade" wiper concept be incorporated to minimize scratching caused by windshield wipers.

SELECTED TRADE STUDY

OPTION 1 ("LUBE BLADE" WINDSHIELD WIPER)

Field maintenance people that are people very knowledgeable state that most of the damage to the windshield occurs during the initial wiping action. Much of the damage is caused by fine layers of dust and grime that collect on the windshield. In the case of the CH-3 wiper system, the wash fluid system can be activated, and 2 seconds later the wiper arm starts its wiping action. The spray from a "spray tube" (figure 45) is applied in a dispersed pattern. The spray pattern from the manifold does not provide uniform saturation of the wiped surface. Consequently, scratching of the windshield, especially from wiper blades that harden from age, results.

It is therefore proposed that the "lube blade" concept as shown in figure 45 be incorporated as means of eliminating this problem. The principle utilized by the "lube blade" is dispersal of the wash fluid, through a jet stream, providing a uniform coverage across the full length of the wiper blade. The wash fluid is dispersed at the wiper blade wiping tip, as shown in figure 45. The fluid is pumped into a tubular manifold and dispersed through jet ports approximately 1 inch apart. The lower part of the wiper blade is formed to act as a valve, blocking off the jets on the retreating side of the blade and concentrating all the flow to the advancing side of the wiper blade. The concentration of the wash fluid at the "tip" point of contact will lubricate the surface and prevent scratching of the windshield surface.

The "lube blade" washer system consists of a pump, reservoir, and wiper blades with built-in spray nozzles as depicted in figure 35, Section VI. The system is operated by a switch. When the switch is placed to the ON position, power is applied to the wiper arm, and simultaneously to the wash fluid pump. After a 1-second time delay, the wiper arm automatically begins to operate. When sufficient wiping is accomplished after three to four cycles, the dispersion of wash fluid is stopped. If further washing is desired, the wash system can be manually engaged.

The incorporation of a wash system for the lube system concept will result in approximately 25 pounds weight increase. (See figure 37, Section VI.)

Cost Analysis

The annual savings in the cost of replacing damaged windshields and by incorporating the wiper system modification is estimated to be $10,600. This is based on a cost trade analysis (refer to table 13) developed for a 10-year life cycle costing.

TABLE 13. COST ANALYSIS

UH-1F/P TRANSPARENCY SYSTEM

OPTION 1 - "LUBE BLADE" WINDSHIELD WIPER

Summary

Present Concept	
Field Maintenance	$ 65,035
Spares	362,700
Total F/M and spares - 10-year LCC	$427,735
Redesign Concept	
Redesign and development	$ 13,935
Kit installation	112,668
Field Maintenance	17,125
Spares	177,625
Total F/M, spares and nonrecurring and recurring R&D - 10-year LCC	$321,353
10-year LCC	$106,382
Annual (average) savings	$ 10,600

TABLE 13. COST ANALYSIS (Continued)

UH-1F/P TRANSPARENCY SYSTEM

OPTION 1 - "LUBE BLADE" WINDSHIELD WIPER

Present Concept

Field Maintenance

WUC-DSS[39] 333 x $14/hr[40]	$ 4,662
Total years	10
Escalation factor 1976-1983	1.395[41]
Total cost 10 years	$65,035

Spares

WUC-DSS 26 at $1,000	$ 26,000
Total years	10
Escalation factor 1976-1983	1.395
Total cost 10 years	$362,700

(39) Maintenance hours attributed to dirt cont, scored and scratched

(40) Maintenance rate, incl direct labor, G&A, and overhead

(41) Escalation factors (reference 6)

TABLE 13. COST ANALYSIS (Continued)

UH-1F/P TRANSPARENCY SYSTEM

OPTION 1 - "LUBE BLADE" WINDSHIELD WIPER

Redesign Concept - Nonrecurring

Tooling - No effort required.

Engineering

Design	150 hr	
TCTO	50 hr	
Total engineering labor	200 hr	
Engineering labor rate	$40/hr	
Engineering labor dollars	$8,000	
Engineering material	35	
Total engineering	$8,035	$ 8,035

Certification

Engineering: by comparison to similar parts	$1,500	
Kits	1,200	
Test	$3,200	
Total certification cost	$5,900	$ 5,900
Total nonrecurring cost		$13,935

TABLE 13. COST ANALYSIS (Continued)

UH-1F/P TRANSPARENCY SYSTEM

OPTION 1 - "LUBE BLADE" WINDSHIELD WIPER

Redesign Concept - Recurring Cost

Field Maintenance

Total WUC attributed to How-Mal dirt-cont, crazed, scored, or scratches = 333 hr at $14/hr =		$ 4,662
Service improvement = 70% x $4,662 =		3,264
Remaining field maintenance due to How-Mal		$ 1,398
Total years		10
		$13,980
Escalation factor 1978-1983		1.225
Total 10-year field maintenance		$17,125

Spares Replacement

Windshield No. of spares		26
Less adjustment for extended service life of 40%		0.40
		10
Revised unit cost		
Current cost	$1,000	
45% current cost	450	
	$1,450	$ 1,450
		$ 14,500
Total years		10
		$145,000
Escalation factor		1.225
Total 10-year spares		$177,625

Redesigned windshield "lube blade" wiper system	
Estimated cost of kit $706 x 123[42] =	$ 86,838
Estimated installation time $210 x 123 =	25,830
	$112,668

(42) 123 aircraft in fleet.

TABLE 13. COST ANALYSIS (Continued)

UH-1F/P TRANSPARENCY SYSTEM

OPTION 1 - "LUBE BLADE" WINDSHIELD WIPER

Engineering Hours Estimate

Design: Study materials, establish basic design, adapt to 2 window installations	42
Vendor coordination	20
Establish and release 1 blade configuration	20
Establish and release 1 W/S wiper installation	16
Miscellaneous changes - design maintenance	8
Subtotal	106
Stress	24
Checking	10
Materials and processing	4
Project office	4
Release	2
Subtotal	44
Total Engineering	150

TABLE 13. COST ANALYSIS (Continued)

UH-1F/P TRANSPARENCY SYSTEM

OPTION 1 - "LUBE BLADE" WINDSHIELD WIPER

Technical Order Support

TCTO:	Authorize field modification to aircraft	14 hr
	Kit proof and changes	2 hr
		16 hr

Flight Manual

T.O.: Airframe maintenance

Add data to describe, install and maintain new installation

T.O. revisions	15 hr
Material cost	$12

T.O.: Illustrated parts breakdown, add changed data to parts list

T.O. revisions	11 hr
Material cost	$9

T.O.: Numerical Index added change data

T.O. revisions	8 hr
Material cost	$14

Total labor hours	50 hr
Cost	$35

This estimate is based on input obtained from transparency design and technical support functions.

TABLE 13. COST ANALYSIS (Concluded)

UH-1F/P TRANSPARENCY SYSTEM

OPTION 1 - "LUBE BLADE" WINDSHIELD WIPER

Pilot's and Copilot's Windshield Wiper Kit

Kit Cost

	Unit	Qty/SS	Total Dollars
Converter assy	175.00	2	350.00
Arm assy	25.00	2	50.00
Blade flex (lube)	18.00	2	36.00
Time delay switch	37.50	1	37.50
Pump and motor	175.00	1	175.00
Reservoir	35.00	1	35.00
Tubing	7.50	3	22.50
			706.00

Installation Cost

	Removal		Instal-lation		Qty/SS	Total Hours
Converter assy	1.0	+	0.50	x	2	3.0
Arm assy	0.1	+	0.40	x	2	1.0
Blade	0.1	+	0.15	x	2	0.5
Time delay switch	0.25	+	0.75	x	1	1.0
Pump and motor	-		4.00	x	1	4.0
Reservoir	-		2.50	x	1	2.5
Tubing	-		1.00	x	3	3.0
						15.0

15 hours at $14.00/hr = $210.00 installation cost.

SECTION IX

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

The paramount desire of the maintenance personnel at the field level and the ALC is to reduce the downtime for aircraft, and reduce the expenditure of maintenance hours and materiel cost required in the servicing of their aircraft. They also are receptive to consideration of any design improvements that will increase the reliability, maintain the desired optical qualities to ensure safety of flight, and reduce operating costs. This supplemental study was programed to achieve this end. The following conclusions resulted from this study.

1. The AFM 66-1 Data File, data obtained from ALC's, and from field audits, etc do provide a data base from which predominant transparency maintenance problems can be identified and the life cycle cost (LCC) impact determined.

2. Applying state-of-the-art technique design changes can be incorporated that will alleviate these maintenance problems. Those changes that are cost effective can be selected by LCC considerations.

3. It is concluded from this study that substantial cost savings can be achieved.

RECOMMENDATIONS

In view of the foregoing conclusions as supported by the analysis contained in this report, it is recommended that the following studies be implemented as soon as practical.

PROPOSED STUDIES FOR IMMEDIATE IMPLEMENTATION

F-4 Aircraft (Windshield and Canopies)

		Annual Savings
Option No. 1	PPG-Liner Material Laminated Configuration for Improved Abrasion Resistance	$662,600
Option No. 2	Improved Canopy Hinge Support Fittings	$ 26,100
Total F-4 transparency system improvement saving		$688,700

C-130 Aircraft (Windshields)

Option No. 1	Improved Windshield Edge Sealing	$136,800
Option No. 2	Windshield Edge Heater	$ 37,700
Total C-130 transparency system improvement saving		$174,500

CH-53 Helicopters (Windshields)

Option No. 1	Glass and PPG-Liner Material for Pilot's and Copilot's Windshield	$ 45,300
Option No. 2	Stretched Acrylic and PPG-Liner Material for Center Windshield	$ 10,200
Option No. 3	Windshield Frame Modification for Improved Sealing	$ 11,100
Total CH-53 transparency system improvement saving		$ 66,600

	Annual Savings
CH-3 Helicopter (Windshields)	
Option No. 1 Glass and PPG-Liner Material for Pilot's and Copilot's Windshield Option No. 2 Stretched Acrylic and PPG-Liner Material for Center Windshield Option No. 3 Windshield Frame Modification for Improved Sealing	$ 48,900
Total CH-3 transparency system improvement saving	$ 48,900
UH-1F/P Helicopter (Windshield System)	
Option No. 1 "Lube Blade" Windshield Wiper	$ 10,600
Total potential annual savings for all aircraft	$989,300
Alternate options are available for:	
CH-53 Helicopter Option No. 4 "Lube Blade Windshield Wiper	$ 20,900
CH-3 Helicopter Option No. 4 "Lube Blade" Windshield Wiper	$ 23,300

FOLLOW-ON STUDIES

The proposed options as listed above represent a portion of all the design improvement candidates that were reviewed. During the selection process, various candidates were discarded because problem areas were not considered to be as critical or the potential cost savings were not considered to be as great as the selected options. In some cases, the candidate changes lacked sufficient data to be considered a viable option. In the interest of

expanding the search for cost reduction, it is recommended that the following studies be pursued at some future date.

1. Special training programs for the care and proper handling of transparencies. In view of a very large amount of abrasion-type damage (80 to 90 percent of scored and scratched How-Mal) that is caused by improper handling by ground and flight crew personnel, a specialized training program would be appropriate. The program would relate the statistics on the expenditures required to maintain and to provide spares for transparencies. It would most importantly be directed in providing the instruction and proper handling procedure required to increase the life of these transparents.

2. Provide a team of highly skilled technicians to buff and polish plastic-type windshields and canopies. The Sierracin Corporation believes that a considerable number of transparents could be saved if this type repair task were accomplished by highly qualified and experienced plastics fabricators. At this time, less than 10 percent of scratched transparents are repaired by polishing and buffing. It is believed that a special team could dramatically increase the number of transparents that could be saved in this manner.

3. Incorporate solid-state anti-icing controllers in lieu of electro-mechanical devices being used for electrically energized anti-icing systems. Significant increases in the sensitivity and reliability have been reported for the solid-state controllers.

4. Incorporate the PPG-liner material in the secondary viewing and observation windows for helicopter-type aircraft. Although the viewing requirements for these windows are not considered to be as critical as the windshield panels, they, too, should be reviewed for modification. A significant improvement in the ability to maintain the desired optical qualities as well as reduced maintenance cost are certain to be realized.

5. Incorporate the PPG-liner material for the stretched acrylic windshield and canopy for the A-7D aircraft. The improved resistance to abrasion will help reduce replacement parts and maintain the desired optical qualities.

6. Incorporate the forward side window sealing provisions as described in Section V. The application of sealant to the faying surface and fillet sealing of the longitudinal support members at the lower extremities of the window panel can be easily accomplished.

APPENDIX

APPENDIX A

SAMPLE MAINTENANCE ANALYSIS MODEL (MAMS) PRINTOUTS

DESIGN/COST MAINTENANCE ANALYSIS MODEL

F-4 TRANSPARENCY WUCS ONAC AND SHOP 1/76-6/77 - MARSHALL STA 11-C3 MAR. 14, 1978 PAGE 1

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	544,662	470,536	$669,099	84,979.93	156.02

12350 AFT CANOPY ASSY $170,115 LSC/YEAR PCT OF LSC 25.42 TOTAL LSC RNK 1 22660.15 MAN HRS PCT OF MHR 26.67 TOTAL MHR RNK 1 41.6040 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF HMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF HMC
799 NO DEFECT	7428.71	32.8	Q INSTALLED	6318.61	85.1	F BETWEEN FLT GND CREW	6302.04	84.8
			X TEST-INSPECT-SERVICE	573.71	7.7	H POST/THRUFLT	294.04	4.0
			P REMOVED	180.45	2.4	M PERIODIC/PHASED INSP	274.57	3.7
			V CLEAN	119.36	1.6	D INFLIGHT NO ABORT	171.95	2.3
			L ADJUST	104.67	1.4	C INFLIGHT ABORT	165.03	2.2
			H EQUIP CK NO RPR RQRD	81.61	1.1	A BEFORE FLT ABORT	63.10	0.8
			U RPLCD AFTER CANBLZTN	25.60	0.3	B BEFORE FLT NO ABORT	60.81	0.8
			T REMOVE FOR CANIBLZTN	16.58	0.2	Q SPECIAL INSPECTION	43.67	0.6
			G RPR/RPLT MINOR PARTS	6.13	0.1	J PREFLIGHT	27.10	0.4
			J CLBRTD-NO ADJMT RQRD	2.00	0.0	E AFTER FLIGHT	12.09	0.2
						R QC CHECK	8.00	0.1
						W IN-SHOP REPAIR	4.50	0.1
						G GROUND ALERT-NOT DGR	1.50	0.0
						P FUNCTIONAL CK FLT	0.33	0.0
127 ADJMT/ALGNMT IMPROPR	5154.37	22.7	L ADJUST	3780.12	73.3	F BETWEEN FLT GND CREW	4141.84	80.4
			G RPR/RPLT MINOR PARTS	833.73	16.2	D INFLIGHT NO ABORT	456.90	8.9
			Y TROUBLESHOOT	195.61	3.8	A BEFORE FLT ABORT	145.34	2.8
			Q INSTALLED	100.31	1.9	H POST/THRUFLT	132.23	2.6
			P REMOVED	73.00	1.4	M PERIODIC/PHASED INSP	116.15	2.3
			A BNCH CK AND REPAIRED	61.60	1.2	E AFTER FLIGHT	58.66	1.1
			C BNCH CK-RPR DEFERRED	48.80	0.9	R QC CHECK	37.50	0.7
			X TEST-INSPECT-SERVICE	20.80	0.4	Q SPECIAL INSPECTION	25.51	0.5
			F REPAIR	19.80	0.4	B BEFORE FLT NO ABORT	20.67	0.4
			K CALIBRATD-ADJMT RQRD	14.10	0.3	C INFLIGHT ABORT	19.80	0.4
			R REMOVE AND REPLACE	6.50	0.1			
935 SCORED OR SCRATCHED	2883.52	12.7	R REMOVE AND REPLACE	1600.21	55.5	F BETWEEN FLT GND CREW	2358.48	81.8
			P REMOVED	571.53	19.8	D INFLIGHT NO ABORT	244.76	8.5
			G RPR/RPLT MINOR PARTS	241.27	8.4	M PERIODIC/PHASED INSP	110.83	3.8
			A BNCH CK AND REPAIRED	203.32	7.1	H POST/THRUFLT	92.01	3.2
			F REPAIR	129.85	4.5	Q SPECIAL INSPECTION	35.00	1.2
			Q INSTALLED	119.02	4.1	B BEFORE FLT NO ABORT	31.01	1.1
			X TEST-INSPECT-SERVICE	13.70	0.5	E AFTER FLIGHT	11.34	0.4
			1 BNCH CK-NRTS-NOT ATH	3.63	0.1	S DEPOT LEVEL MAINTNCE	0.10	0.0
			V CLEAN	1.50	0.1			
			Y TROUBLESHOOT	0.50	0.0			
000 NO DEF-RMVD-OTH MAINT	1208.96	5.3	P REMOVED	496.03	41.0	F BETWEEN FLT GND CREW	919.71	76.1
			Q INSTALLED	479.32	39.6	M PERIODIC/PHASED INSP	138.72	11.5
			S REMOVE AND REINSTALL	202.86	16.8	H POST/THRUFLT	68.31	5.7
			L ADJUST	16.09	1.3	D INFLIGHT NO ABORT	41.67	3.4
			G RPR/RPLT MINOR PARTS	9.00	0.7	J PREFLIGHT	21.75	1.8
			R REMOVE AND REPLACE	5.75	0.5	A BEFORE FLT ABORT	7.80	0.6
						P FUNCTIONAL CK FLT	6.00	0.5
						R QC CHECK	5.00	0.4

Figure A-1. F-4 Design/Cost MAMS

DESIGN/COST MAINTENANCE ANALYSIS MODEL

F-4 TRANSPARENCY WUCS ONAC AND SHOP 1/76-6/77 - MARSHALL STA 11-C3 MAR. 14, 1978 PAGE 2

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	544,662	470,536	$669,099	84,979.93	156.02

12350 AFT CANOPY ASSY (CONT.) $170,115 LSC/YEAR | PCT OF LSC 25.42 TOTAL | LSC RNK 1 | 22660.15 MAN HRS | PCT OF MHR 26.67 TOTAL | MHR RNK 1 | 41.6040 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC
190 CRACKED	842.12	3.7
135 BINDING,STUCK,JAMMED	779.07	3.4
105 LOOSE/OMGD BOLTS,NUT	578.54	2.6
605 CRAZED	463.69	2.0
812 NO DEF-ASSOC EQP MAL	442.90	2.0
910 CHIPPED	412.16	1.8

ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF MMAC
R REMOVE AND REPLACE	456.55	54.2
G RPR/RPLT MINOR PARTS	221.71	26.3
A BNCH CK AND REPAIRED	90.51	10.7
P REMOVED	50.27	6.0
Q INSTALLED	15.67	1.9
1 BNCH CK-NRTS-NOT ATH	4.00	0.5
F REPAIR	3.42	0.4
Y TROUBLESHOOT	361.76	46.4
L ADJUST	266.44	34.2
X TEST-INSPECT-SERVICE	72.14	9.3
R REMOVE AND REPLACE	24.00	3.1
G RPR/RPLT MINOR PARTS	17.35	2.2
V CLEAN	15.00	1.9
P REMOVED	14.37	1.8
Z CORROSION REPAIR	4.50	0.6
F REPAIR	3.50	0.4
G RPR/RPLT MINOR PARTS	389.26	63.7
P REMOVED	79.29	13.7
A BNCH CK AND REPAIRED	60.66	10.5
F REPAIR	47.88	8.3
Q INSTALLED	11.50	2.0
R REMOVE AND REPLACE	4.70	0.8
Y TROUBLESHOOT	2.92	0.5
X TEST-INSPECT-SERVICE	2.00	0.3
L ADJUST	1.33	0.2
R REMOVE AND REPLACE	268.35	57.8
P REMOVED	89.17	19.2
Q INSTALLED	72.01	15.5
G RPR/RPLT MINOR PARTS	16.00	3.5
A BNCH CK AND REPAIRED	11.00	2.4
1 BNCH CK-NRTS-NOT ATH	3.65	0.8
X TEST-INSPECT-SERVICE	3.00	0.6
Y TROUBLESHOOT	0.50	0.1
R REMOVE AND REPLACE	364.50	82.3
G RPR/RPLT MINOR PARTS	72.60	16.4
X TEST-INSPECT-SERVICE	2.30	0.5
Y TROUBLESHOOT	2.00	0.5
H EQUIP CK NO RPR RQRD	1.50	0.3
R REMOVE AND REPLACE	263.70	64.0
G RPR/RPLT MINOR PARTS	77.51	18.8

WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF MMAC
F BETWEEN FLT GND CREW	661.16	78.5
J PREFLIGHT	86.52	10.3
M PERIODIC/PHASED INSP	55.67	6.6
D INFLIGHT NO ABORT	12.50	1.5
H POST/1HRUFLT	10.17	1.2
Q SPECIAL INSPECTION	6.00	0.9
C INFLIGHT ABORT	6.00	0.7
S DEPOT LEVEL MAINTNCE	2.10	0.2
F BETWEEN FLT GND CREW	[illegible]	[illegible]
D INFLIGHT NO ABORT	131.00	16.8
E AFTER FLIGHT	112.94	14.5
B BEFORE FLT NO ABORT	22.00	2.8
A BEFORE FLT ABORT	18.34	2.4
G GROUND ALERT-NOT DGR	10.50	1.3
M PERIODIC/PHASED INSP	4.00	0.5
J PREFLIGHT	3.70	0.5
H POST/1HRUFLT	3.00	0.4
N GROUNT ALERT-DEGRAD	2.00	0.3
L TRAINING OR MAINTNCE	1.50	0.2
F BETWEEN FLT GND CREW	339.03	58.6
M PERIODIC/PHASED INSP	115.21	19.9
H POST/1HRUFLT	77.18	13.3
W IN-SHOP REPAIR	14.80	2.6
R QC CHECK	9.20	1.6
Q SPECIAL INSPECTION	8.87	1.5
D INFLIGHT NO ABORT	8.67	1.5
K HOURLY POSTFLIGHT	4.58	0.8
B BEFORE FLT NO ABORT	1.00	0.2
F BETWEEN FLT GND CREW	378.09	81.5
D INFLIGHT NO ABORT	52.47	11.3
X ENGINE TEST STAND OP	16.67	3.6
M PERIODIC/PHASED INSP	13.20	2.8
Q SPECIAL INSPECTION	3.00	0.6
1	0.25	0.1
F BETWEEN FLT GND CREW	440.40	99.4
C INFLIGHT ABORT	2.00	0.5
M PERIODIC/PHASED INSP	0.50	0.1
F BETWEEN FLT GND CREW	335.65	81.4
H POST/1HRUFLT	36.01	8.7

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Figure A-1. F-4 Design/Cost MAMS (Continued)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

F-4 TRANSPARENCY WUCS ONAC AND SHOP 1/76-5/77 - MARSHALL STA 11-C3 MAR. 14, 1978 PAGE 3

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	544,662	470,536	$669,099	84,979.93	156.02

12350 AFT CANOPY ASSY (CONT.)	$170,115 LSC/YEAR	PCT OF LSC 25.42	TOTAL	LSC RNK 1	22600.15 MAN HRS	PCT OF MHR 26.67	TOTAL	MHR RNK 1	41.6040 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF WUC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF WUC
			P REMOVED	59.11	14.3	M PERIODIC/PHASED INSP	22.50	5.5
			Q INSTALLED	10.00	2.4	D INFLIGHT NO ABORT	18.00	4.4
			1 BNCH CK-NRTS-NOT ATH	1.33	0.3			
			X TEST-INSPECT-SERVICE	0.50	0.1			
170 CORRODED-MILD/MODRTE	324.28	1.4	R REMOVE AND REPLACE	164.87	50.6	F BETWEEN FLT GND CREW	194.33	59.9
			Z CORROSION REPAIR	130.09	40.1	M PERIODIC/PHASED INSP	63.32	19.5
			G RPR/RPLT MINOR PARTS	15.68	4.8	S DEPOT LEVEL MAINTNCE	54.70	16.9
			P REMOVED	6.97	2.1	4 CORROSION CONTR INSP	6.17	1.9
			V CLEAN	6.67	2.1	K HOURLY POSTFLIGHT	2.08	0.6
						H POST/THRUFLT	1.50	0.5
						Q SPECIAL INSPECTION	1.17	0.4
						R QC CHECK	1.00	0.3
020 WORN CHAFED OR FRAYD	296.24	1.3	R REMOVE AND REPLACE	66.67	22.5	F BETWEEN FLT GND CREW	248.59	83.9
			F REPAIR	52.67	17.8	M PERIODIC/PHASED INSP	27.52	9.3
			G RPR/RPLT MINOR PARTS	48.56	16.4	H POST/THRUFLT	6.13	2.1
			X TEST-INSPECT-SERVICE	29.60	10.0	Q SPECIAL INSPECTION	6.00	2.0
			L ADJUST	26.00	8.8	J PREFLIGHT	4.00	1.4
			P REMOVED	25.40	8.6	E AFTER FLIGHT	3.00	1.0
			Y TROUBLESHOOT	24.80	8.4	K HOURLY POSTFLIGHT	0.50	0.2
			A BNCH CK AND REPAIRED	22.34	7.5	R QC CHECK	0.50	0.2
780 BENT,BUCKLED,COLLASP	264.92	1.2	G RPR/RPLT MINOR PARTS	103.57	39.1	F BETWEEN FLT GND CREW	214.82	81.1
			R REMOVE AND REPLACE	93.51	35.3	R QC CHECK	30.50	11.5
			Q INSTALLED	46.54	17.6	H POST/THRUFLT	11.00	4.2
			P REMOVED	18.40	6.9	S DEPOT LEVEL MAINTNCE	7.60	2.9
			X TEST-INSPECT-SERVICE	1.00	0.4	M PERIODIC/PHASED INSP	1.00	0.4
			Y TROUBLESHOOT	1.00	0.4			
			1 BNCH CK-NRTS-NOT ATH	0.90	0.3			
070 BROKEN	235.56	1.0	Q INSTALLED	73.80	31.3	F BETWEEN FLT GND CREW	202.21	85.8
			P REMOVED	50.24	21.3	H POST/THRUFLT	26.12	11.1
			A BNCH CK AND REPAIRED	32.20	13.7	M PERIODIC/PHASED INSP	7.00	3.0
			R REMOVE AND REPLACE	27.80	11.8	C INFLIGHT ABORT	0.25	0.1
			G RPR/RPLT MINOR PARTS	24.29	10.3			
			X TEST-INSPECT-SERVICE	12.00	5.1			
			C BNCH CK-RPR DEFERRED	10.00	4.2			
			F REPAIR	5.00	2.1			
			1 BNCH CK-NRTS-NOT ATH	0.25	0.1			
520 PITTED	207.04	0.9	R REMOVE AND REPLACE	207.04	100.0	F BETWEEN FLT GND CREW	207.04	100.0
932 DOES NOT ENGAGE/LOCK	154.21	0.7	R REMOVE AND REPLACE	92.00	59.7	F BETWEEN FLT GND CREW	115.70	75.0
			L ADJUST	26.00	16.9	D INFLIGHT NO ABORT	23.00	14.9
			X TEST-INSPECT-SERVICE	25.50	16.5	H POST/THRUFLT	15.50	10.1
			P REMOVED	8.00	5.2			
			F REPAIR	1.70	1.1			

Figure A-1. F-4 Design/Cost MAMS (Continued)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

F-4 TRANSPARENCY WUCS ONAC AND SHOP 1/76-6/77 - MARSHALL STA 11-C3 MAR. 14, 1978 PAGE 4

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	544,662	470,536	$669,099	84,979.93	156.02

12350 AFT CANOPY ASSY (CONT.) $170,115 LSC/YEAR | PCT OF LSC 25.42 TOTAL | LSC RNK 1 | 22660.15 MAN HRS | PCT OF MHR 26.67 TOTAL | MHR RNK 1 | 41.6040 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF HMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF HMC
			Y TROUBLESHOOT	1.00	0.6			
730 LOOSE	148.63	0.7	P REMOVED	45.57	30.7	F BETWEEN FLT GND CREW	102.98	69.3
			F REPAIR	26.65	17.9	M PERIODIC/PHASED INSP	11.97	8.1
			G RPR/RPLT MINOR PARTS	24.44	16.4	D INFLIGHT NO ABORT	8.25	5.6
			Y TROUBLESHOOT	23.37	15.7	C INFLIGHT ABORT	7.50	5.0
			L ADJUST	12.50	8.4	R QC CHECK	6.00	4.0
			C BNCH CK-RPR DEFERRED	10.10	6.8	H POST/THRUFLT	3.92	2.6
			X TEST-INSPECT-SERVICE	6.00	4.0	K HOURLY POSTFLIGHT	3.00	2.0
						A BEFORE FLT ABORT	2.00	1.3
						S DEPOT LEVEL MAINTNCE	2.00	1.3
						P FUNCTIONAL CK FLT	1.00	0.7
108 MISSING BOLTS,NUTS..	114.96	0.5	G RPR/RPLT MINOR PARTS	109.66	95.4	F BETWEEN FLT GND CREW	65.50	57.0
			A BNCH CK AND REPAIRED	3.80	3.3	M PERIODIC/PHASED INSP	34.29	29.8
			L ADJUST	1.50	1.3	Q SPECIAL INSPECTION	6.50	5.7
						K HOURLY POSTFLIGHT	4.17	3.6
						H POST/THRUFLT	3.40	3.0
						R QC CHECK	0.80	0.7
						S DEPOT LEVEL MAINTNCE	0.30	0.3
848 DELAMINATED	109.34	0.5	P REMOVED	48.50	44.4	F BETWEEN FLT GND CREW	48.84	44.7
			R REMOVE AND REPLACE	47.01	43.0	M PERIODIC/PHASED INSP	36.00	32.9
			Q INSTALLED	10.50	9.6	H POST/THRUFLT	12.00	11.0
			X TEST-INSPECT-SERVICE	2.00	1.8	D INFLIGHT NO ABORT	10.50	9.6
			1 BNCH CK-NRTS-NOT ATH	1.33	1.2	Q SPECIAL INSPECTION	2.00	1.8
230 DIRTY CONTAM SATURAT	97.93	0.4	V CLEAN	83.23	85.0	M PERIODIC/PHASED INSP	31.07	31.7
			P REMOVED	11.70	11.9	L TRAINING OR MAINTNCE	23.17	23.7
			G RPR/RPLT MINOR PARTS	2.58	2.6	E AFTER FLIGHT	13.50	13.8
			Z CORROSION REPAIR	0.42	0.4	J PREFLIGHT	11.90	12.2
						H POST/THRUFLT	8.70	8.9
						F BETWEEN FLT GND CREW	6.83	7.0
						R QC CHECK	1.25	1.3
						K HOURLY POSTFLIGHT	1.00	1.0
						Q SPECIAL INSPECTION	0.50	0.5
381 LEAKING INT OR EXT	65.24	0.3	Y TROUBLESHOOT	50.64	77.6	F BETWEEN FLT GND CREW	46.24	70.9
			G RPR/RPLT MINOR PARTS	10.80	16.6	D INFLIGHT NO ABORT	15.00	23.0
			L ADJUST	3.80	5.8	J PREFLIGHT	4.00	6.1
750 MISSING	48.67	0.2	Q INSTALLED	29.75	61.1	F BETWEEN FLT GND CREW	36.50	75.0
			G RPR/RPLT MINOR PARTS	18.92	38.9	H POST/THRUFLT	9.75	20.0
						M PERIODIC/PHASED INSP	1.42	2.9
						J PREFLIGHT	1.00	2.1
867 CORRODED-SEVERE	41.00	0.2	Z CORROSION REPAIR	36.00	87.8	S DEPOT LEVEL MAINTNCE	36.00	87.8
			G RPR/RPLT MINOR PARTS	5.00	12.2	H POST/THRUFLT	5.00	12.2

Figure A-1. F-4 Design/Cost MAMS (Continued)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

F-4 TRANSPARENCY WUCS ONAC AND SHOP 1/76-6/77 - MARSHALL STA 11-C3 MAR. 14, 1978 PAGE 5

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	544,662	470,536	$669,099	84,979.93	156.02

12350 AFT CANOPY ASSY (CONT.) $170,115 LSC/YEAR | PCT OF LSC 25.42 TOTAL | LSC RNK 1 | 22650.15 MAN HRS | PCT OF MHR 26.67 TOTAL | MHR RNK 1 | 41.6040 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF HMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF HMC
301 FOREIGN OBJ DAMAGE	36.75	0.2	P REMOVED	27.34	74.4	F BETWEEN FLT GND CREW	26.00	70.7
			G RPR/RPLT MINOR PARTS	5.42	14.7	M PERIODIC/PHASED INSP	6.75	18.4
			X TEST-INSPECT-SERVICE	4.00	10.9	A BEFORE FLT ABORT	3.00	8.2
						Q SPECIAL INSPECTION	1.00	2.7
718 IMPROP RESP-MECH IPT	33.80	0.1	Y TROUBLESHOOT	33.80	100.0	F BETWEEN FLT GND CREW	17.50	51.8
						A BEFORE FLT ABORT	13.80	40.8
						D INFLIGHT NO ABORT	2.50	7.4
710 BEARING FAILURE	33.64	0.1	R REMOVE AND REPLACE	19.50	58.0	F BETWEEN FLT GND CREW	25.30	75.2
			P REMOVED	8.50	24.7	A BEFORE FLT ABORT	8.33	24.8
			Q INSTALLED	5.83	17.3			
117 DETERIORATED	28.52	0.1	G RPR/RPLT MINOR PARTS	17.35	60.8	F BETWEEN FLT GND CREW	17.60	61.7
			P REMOVED	8.00	28.1	M PERIODIC/PHASED INSP	7.92	27.8
			Y TROUBLESHOOT	2.00	7.0	K HOURLY POSTFLIGHT	3.00	10.5
			Z CORROSION REPAIR	1.00	3.5			
			F REPAIR	0.17	0.6			
804 NO DEF-SCH MAINT/MOD	23.10	0.1	P REMOVED	18.90	81.8	S DEPOT LEVEL MAINTNCE	23.10	100.0
			R REMOVE AND REPLACE	2.10	9.1			
			0	2.10	9.1			
108 BRK/MSG SAFETY WIRE	21.34	0.1	G RPR/RPLT MINOR PARTS	21.25	99.6	M PERIODIC/PHASED INSP	19.00	89.0
			Q INSTALLED	0.08	0.4	F BETWEEN FLT GND CREW	1.00	4.7
						K HOURLY POSTFLIGHT	0.50	2.3
						Q SPECIAL INSPECTION	0.42	2.0
						H POST/THRUFLT	0.25	1.2
						D INFLIGHT NO ABORT	0.17	0.8
599 TRAVEL/EXT INCORRECT	20.50	0.1	G RPR/RPLT MINOR PARTS	20.50	100.0	F BETWEEN FLT GND CREW	20.00	97.6
						Q SPECIAL INSPECTION	0.50	2.4
242 FAILED TO OPERATE	18.00	0.1	Y TROUBLESHOOT	15.30	85.0	D INFLIGHT NO ABORT	11.30	62.8
			P REMOVED	2.20	12.2	F BETWEEN FLT GND CREW	4.00	22.2
			G RPR/RPLT MINOR PARTS	0.50	2.8	S DEPOT LEVEL MAINTNCE	2.20	12.2
						E AFTER FLIGHT	0.50	2.8
947 TORN	15.92	0.1	G RPR/RPLT MINOR PARTS	13.92	87.4	M PERIODIC/PHASED INSP	11.25	70.7
			Y TROUBLESHOOT	2.00	12.6	J PREFLIGHT	2.67	16.8
						F BETWEEN FLT GND CREW	2.00	12.6
425 NICKED	14.25	0.1	P REMOVED	6.50	45.6	M PERIODIC/PHASED INSP	10.25	71.9
			Q INSTALLED	5.75	40.4	B BEFORE FLT NO ABORT	2.00	14.0
			L ADJUST	2.00	14.0	F BETWEEN FLT GND CREW	2.00	14.0
469 BUSHING WORN/DAMAGED	13.50	0.1	P REMOVED	9.50	70.4	F BETWEEN FLT GND CREW	9.50	70.4

Figure A-1. F-4 Design/Cost MAMS (Continued)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

F-4 TRANSPARENCY WUCS ONAC AND SHOP 1/75-6/77 - MARSHALL STA 11-C3 MAR. 14, 1978 PAGE 6

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	544,662	470,536	$669,099	84,979.97	156.02

12350 AFT CANOPY ASSY (CONT.) $170,115 LSC/YEAR | PCT OF LSC 25.42 TOTAL | LSC RNK 1 | 22660.15 MAN HRS | PCT OF MHR 26.67 TOTAL | MHR RNK 1 | 41.6046 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF MMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF MMC
			R REMOVE AND REPLACE	4.00	29.6	M PERIODIC/PHASED INSP	4.00	29.6
008 NOISY	12.75	0.1	L ADJUST	12.75	100.0	A BEFORE FLT ABORT	12.75	100.0
585 SHEARED	10.30	0.0	P REMOVED	10.30	100.0	F BETWEEN FLT GND CREW	10.30	100.0
410 LACK OF/IMPROPR LUBE	9.90	0.0	V CLEAN	4.27	43.1	F BETWEEN FLT GND CREW	4.10	41.4
			Y TROUBLESHOOT	3.50	35.4	D INFLIGHT NO ABORT	3.00	30.3
			L ADJUST	1.50	15.2	B BEFORE FLT NO ABORT	1.50	15.2
			C RPR/RPLT MINOR PARTS	0.33	3.3	M PERIODIC/PHASED INSP	1.30	13.1
			F REPAIR	0.30	3.0			
246 IMPROP/FAULTY MAINT	8.58	0.0	G RPR/RPLT MINOR PARTS	8.58	100.0	F BETWEEN FLT GND CREW	4.08	47.6
						M PERIODIC/PHASED INSP	2.00	23.3
						H POST/THRU FLT	1.50	17.5
						S DEPOT LEVEL MAINTNCE	1.00	11.7
805 NO DEF-NOC-OTH MAINT	8.10	0.0	L ADJUST	5.30	65.4	D INFLIGHT NO ABORT	5.30	65.4
			Q INSTALLED	2.80	34.6	F BETWEEN FLT GND CREW	2.80	34.6
540 PUNCTURED	8.00	0.0	P REMOVED	8.00	100.0	F BETWEEN FLT GND CREW	8.00	100.0
303 BIRD STRIKE DAMAGE	6.58	0.0	P REMOVED	4.00	60.8	F BETWEEN FLT GND CREW	4.00	60.8
			R REMOVE AND REPLACE	2.58	39.2	H POST/THRUFLT	2.58	39.2
167 TORQUE INCORRECT	6.00	0.0	L ADJUST	6.00	100.0	F BETWEEN FLT GND CREW	6.00	100.0
525 PRESSURE INCORRECT	4.50	0.0	Y TROUBLESHOOT	4.50	100.0	D INFLIGHT NO ABORT	4.50	100.0
160 CONTACTS/CONN DEFECT	4.00	0.0	R REMOVE AND REPLACE	4.00	100.0	F BETWEEN FLT GND CREW	4.00	100.0
948 NO DEF-OPERATOR ERR	4.00	0.0	X TEST-INSPECT-SERVICE	2.00	50.0	B BEFORE FLT NO ABORT	2.00	50.0
			Y TROUBLESHOOT	2.00	50.0	J PREFLIGHT	2.00	50.0
374 INTERNAL FAILURE	3.50	0.0	I BNCH CK-NRTS-NOT ATH	2.00	57.1	F BETWEEN FLT GND CREW	3.50	100.0
			X TEST-INSPECT-SERVICE	1.50	42.9			
553 DOES NOT MEET SPEC	2.30	0.0	Y TROUBLESHOOT	2.30	100.0	Y RECEIPT FROM STOCK	2.30	100.0
092 MISMATCHED PARTS	1.75	0.0	G RPR/RPLT MINOR PARTS	1.75	100.0	M PERIODIC/PHASED INSP	1.75	100.0
130 CHANGE OF VALUE	1.50	0.0	L ADJUST	1.50	100.0	F BETWEEN FLT GND CREW	1.50	100.0
669 POTTING MATL MELTING	1.50	0.0	X TEST-INSPECT-SERVICE	1.50	100.0	R QC CHECK	1.50	100.0
116 CUT	1.17	0.0	G RPR/RPLT MINOR PARTS	1.17	100.0	M PERIODIC/PHASED INSP	1.17	100.0
090 DEFECTIVE LAMP/METER	0.92	0.0	G RPR/RPLT MINOR PARTS	0.92	100.0	F BETWEEN FLT GND CREW	0.92	100.0

Figure A-1. F-4 Design/Cost MAMS (Continued)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

F-4 TRANSPARENCY WUCS ONAC AND SHOP 1/76-6/77 - MARSHALL STA 11-C3 MAR. 14, 1978 PAGE 7

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	544,662	470,536	$669,099	84,979.93	156.02

12350 AFT CANOPY ASSY (CONT.) $170,115 LSC/YEAR | PCT OF LSC 25.42 TOTAL | LSC RNK 1 | 22660.15 MAN HRS | PCT OF MHR 26.67 TOTAL | MHR RNK 1 | 41.6040 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF HMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF HMC
865 PROT COAT/SEALNT DEF	0.80	0.0	Z CORROSION REPAIR	0.80	100.0	M PERIODIC/PHASED INSP	0.80	100.0
561 UNABLE TO ADJ TO LMT	0.50	0.0	L ADJUST	0.50	100.0	H POST/THRUFLT	0.50	100.0
719 BRK/FRYED BND/GND WR	0.50	0.0	G RPR/RPLT MINOR PARTS	0.50	100.0	Q SPECIAL INSPECTION	0.50	100.0
729 DECOUPLED	0.50	0.0	P REMOVED	0.50	100.0	F BETWEEN FLT GND CREW	0.50	100.0
503 SUDDEN STOP	0.42	0.0	Y TROUBLESHOOT	0.42	100.0	D INFLIGHT NO ABORT	0.42	100.0
609 OUT OF TRACK	0.42	0.0	G RPR/RPLT MINOR PARTS	0.42	100.0	H POST/THRUFLT	0.42	100.0
818 IMPEDANCE INCORRECT	0.30	0.0	G RPR/RPLT MINOR PARTS	0.30	100.0	M PERIODIC/PHASED INSP	0.30	100.0

Figure A-1. F-4 Design/Cost MAMS (Continued)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

F-4 TRANSPARENCY 54CG ONAC AND SHOP 1/76-6/77 - MARSHALL STA 11-C3 MAR. 14, 1978 PAGE 8

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	544,662	470,536	$669,099	84,979.93	156.02

12320 FORWARD CANOPY ASSY $141,771 LSC/YEAR | PCT OF LSC 21.19 TOTAL | LSC RNK 2 | 19797.59 MAN HRS | PCT OF MHR 23.30 TOTAL | MHR RNK 2 | 36.3484 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF MMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF MMC
799 NO DEFECT	6748.23	34.1	Q INSTALLED	6021.98	89.2	F BETWEEN FLT GND CREW	6012.93	89.1
			X TEST-INSPECT-SERVICE	419.06	6.2	D INFLIGHT NO ABORT	363.84	5.4
			L ADJUST	127.51	1.9	H POST/THRUFLT	93.46	1.4
			H EQUIP CK NO RPR RQRD	105.96	1.6	M PERIODIC/PHASED INSP	88.54	1.3
			P REMOVED	50.04	0.8	A BEFORE FLT ABORT	75.60	1.1
			C BNCH CK-RPR DEFERRED	8.67	0.1	C INFLIGHT ABORT	43.50	0.6
			T REMOVE FOR CANIBLZTN	4.83	0.1	B BEFORE FLT NO ABORT	33.30	0.5
			G RPR/RPLT MINOR PARTS	4.67	0.1	S DEPOT LEVEL MAINTNCE	14.00	0.2
			U RPLCD AFTER CANBLZTN	2.50	0.0	Q SPECIAL INSPECTION	12.00	0.2
			R REMOVE AND REPLACE	2.08	0.0	P FUNCTIONAL CK FLT	5.00	0.1
			B BNCH CK-NO RPR RQRD	0.33	0.0	R QC CHECK	4.50	0.1
						K HOURLY POSTFLIGHT	0.83	0.0
						W IN-SHOP REPAIR	0.50	0.0
						Y RECEIPT FROM STOCK	0.33	0.0
127 ADJMT/ALGNMT IMPROPR	4208.97	21.3	L ADJUST	2805.13	68.1	F BETWEEN FLT GND CREW	2617.18	62.2
			G RPR/RPLT MINOR PARTS	1105.62	25.3	D INFLIGHT NO ABORT	835.53	19.9
			Y TROUBLESHOOT	115.31	2.7	H POST/THRUFLT	325.51	7.7
			X TEST-INSPECT-SERVICE	38.80	0.9	M PERIODIC/PHASED INSP	215.96	5.1
			R REMOVE AND REPLACE	25.00	0.6	A BEFORE FLT ABORT	69.27	1.6
			Q INSTALLED	22.00	0.5	E AFTER FLIGHT	61.51	1.5
			F REPAIR	19.50	0.5	K HOURLY POSTFLIGHT	47.51	1.1
			P REMOVED	9.90	0.2	Q SPECIAL INSPECTION	25.00	0.6
			A BNCH CK AND REPAIRED	4.20	0.1	J PREFLIGHT	4.50	0.1
			1 BNCH CK-NRTS-NOT ATH	3.50	0.1	B BEFORE FLT NO ABORT	3.80	0.1
						R QC CHECK	3.20	0.1
835 SCORED OR SCRATCHED	2753.65	13.9	R REMOVE AND REPLACE	1767.49	64.2	F BETWEEN FLT GND CREW	2018.19	73.3
			P REMOVED	416.43	15.1	D INFLIGHT NO ABORT	394.00	14.3
			G RPR/RPLT MINOR PARTS	190.62	6.9	H POST/THRUFLT	243.70	8.9
			A BNCH CK AND REPAIRED	112.98	4.1	M PERIODIC/PHASED INSP	94.01	3.4
			Q INSTALLED	97.11	3.5	R QC CHECK	3.75	0.1
			L ADJUST	86.51	3.1			
			F REPAIR	52.81	1.9			
			V CLEAN	16.00	0.6			
			C BNCH CK-RPR DEFERRED	7.70	0.3			
			1 BNCH CK-NRTS-NOT ATH	3.00	0.1			
			X TEST-INSPECT-SERVICE	2.50	0.1			
			Y TROUBLESHOOT	0.50	0.0			
800 NO DEF-RMVD-OTH MAINT	826.49	4.2	Q INSTALLED	370.11	44.8	F BETWEEN FLT GND CREW	711.34	86.1
			P REMOVED	353.59	42.8	M PERIODIC/PHASED INSP	85.10	10.3
			S REMOVE AND REINSTALL	54.86	6.6	H POST/THRUFLT	11.05	1.3
			L ADJUST	22.40	2.7	D INFLIGHT NO ABORT	8.50	1.0
			X TEST-INSPECT-SERVICE	13.54	1.6	J PREFLIGHT	7.50	0.9
			Y TROUBLESHOOT	10.00	1.2	C INFLIGHT ABORT	3.00	0.4
			G RPR/RPLT MINOR PARTS	2.05	0.2			

Figure A-1. F-4 Design/Cost MAMS (Continued)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

F-4 TRANSPARENCY WUCS ONAC AND SHOP 1/76-6/77 - MARSHALL STA 11-C3 MAR. 14, 1978 PAGE 9

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	544,662	470,536	$669,099	84,979.93	156.02

12320 FORWARD CANOPY ASSY (CONT.) $141,771 LSC/YEAR | PCT OF LSC 21.19 TOTAL | LSC RNK 2 | 19797.59 MAN HRS | PCT OF MHR 23.30 TOTAL | MHR RNK 2 | 36.3484 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF HMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF HMC
780 BENT,BUCKLED,COLLASP	646.77	3.3	R REMOVE AND REPLACE	445.05	68.8	F BETWEEN FLT GND CREW	458.12	70.8
			Q INSTALLED	63.01	9.7	D INFLIGHT NO ABORT	147.38	22.8
			P REMOVED	51.30	7.9	H POST/THRUFLT	18.00	2.8
			L ADJUST	32.01	4.9	R QC CHECK	15.60	2.4
			G RPR/RPLT MINOR PARTS	31.43	4.9	M PERIODIC/PHASED INSP	3.33	0.5
			A BNCH CK AND REPAIRED	19.00	2.9	W IN-SHOP REPAIR	1.50	0.2
			1 BNCH CK-NRTS-NOT ATH	2.00	0.3	K HOURLY POSTFLIGHT	1.33	0.2
			Y TROUBLESHOOT	1.97	0.3	S DEPOT LEVEL MAINTNCE	1.30	0.2
			X TEST-INSPECT-SERVICE	1.00	0.2			
105 LOOSE/DMGD BOLTS,NUT	523.54	2.6	G RPR/RPLT MINOR PARTS	463.24	88.5	F BETWEEN FLT GND CREW	291.43	55.7
			F REMOVED	23.60	4.5	M PERIODIC/PHASED INSP	151.33	28.9
			A BNCH CK AND REPAIRED	19.23	3.7	H POST/THRUFLT	46.50	8.9
			Q INSTALLED	8.00	1.5	Q SPECIAL INSPECTION	14.17	2.7
			R REMOVE AND REPLACE	4.50	0.9	K HOURLY POSTFLIGHT	8.75	1.7
			Y TROUBLESHOOT	2.50	0.5	R QC CHECK	4.05	0.8
			F REPAIR	2.17	0.4	S DEPOT LEVEL MAINTNCE	3.10	0.6
			L ADJUST	0.30	0.1	D INFLIGHT NO ABORT	2.62	0.5
						J PREFLIGHT	1.00	0.2
						L TRAINING OR MAINTNCE	0.58	0.1
605 CRAZED	455.54	2.3	G RPR/RPLT MINOR PARTS	164.14	36.0	F BETWEEN FLT GND CREW	320.25	70.3
			R REMOVE AND REPLACE	153.10	33.6	D INFLIGHT NO ABORT	44.09	9.7
			P REMOVED	92.97	20.4	H POST/THRUFLT	31.84	7.0
			Q INSTALLED	21.00	4.6	M PERIODIC/PHASED INSP	27.26	6.0
			Y TROUBLESHOOT	9.60	2.1	X ENGINE TEST STAND OP	14.00	3.1
			F REPAIR	6.42	1.4	J PREFLIGHT	9.00	2.0
			X TEST-INSPECT-SERVICE	4.50	1.0	E AFTER FLIGHT	8.00	1.8
			1 BNCH CK-NRTS-NOT ATH	3.30	0.7	C INFLIGHT ABORT	1.00	0.2
			C BNCH CK-RPR DEFERRED	0.50	0.1	S DEPOT LEVEL MAINTNCE	0.10	0.0
135 BINDING,STUCK,JAMMED	380.93	1.9	Y TROUBLESHOOT	171.87	45.1	F BETWEEN FLT GND CREW	300.87	79.0
			L ADJUST	170.26	44.7	A BEFORE FLT ABORT	24.59	6.5
			P REMOVED	16.33	4.3	D INFLIGHT NO ABORT	23.23	6.1
			G RPR/RPLT MINOR PARTS	8.80	2.3	E AFTER FLIGHT	16.64	4.4
			R REMOVE AND REPLACE	6.00	1.6	M PERIODIC/PHASED INSP	10.50	2.8
			X TEST-INSPECT-SERVICE	4.00	1.1	H POST/THRUFLT	3.00	0.8
			V CLEAN	1.50	0.4	S DEPOT LEVEL MAINTNCE	2.00	0.5
			Z CORROSION REPAIR	1.50	0.4			
			F REPAIR	0.60	0.2			
910 CHIPPED	338.75	1.7	R REMOVE AND REPLACE	240.74	71.1	F BETWEEN FLT GND CREW	227.06	67.0
			G RPR/RPLT MINOR PARTS	62.01	18.3	H POST/THRUFLT	54.51	16.1
			P REMOVED	34.00	10.0	D INFLIGHT NO ABORT	51.51	15.2
			Y TROUBLESHOOT	1.50	0.4	R QC CHECK	5.67	1.7
			X TEST-INSPECT-SERVICE	0.50	0.1			

Figure A-1. F-4 Design/Cost MAMS (Continued)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

F-4 TRANSPARENCY WUCS ORAC AND SHOP 1/73-6/77 - MARSHALL STA 11-C3 MAR. 14, 1978 PAGE 10

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	544,662	470,536	$669,099	84,979.93	156.02

12320 FORWARD CANOPY ASSY (CONT.) $141,771 LSC/YEAR | PCT OF LSC 21.19 TOTAL | LSC RNK 2 | 19797.59 MAN HRS | PCT OF MHR 23.30 TOTAL | MHR RNK 2 | 36.3184 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF MMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF MMC
020 WORN CHAFED OR FRAYD	325.57	1.6	G RPR/RPLT MINOR PARTS	124.95	38.4	F BETWEEN FLT GND CREW	263.53	80.9
			A BNCH CK AND REPAIRED	78.40	24.1	H POST/THRUFLT	18.84	5.8
			R REMOVE AND REPLACE	50.41	15.5	M PERIODIC/PHASED INSP	18.20	5.6
			F REPAIR	31.30	9.6	Q SPECIAL INSPECTION	7.80	2.4
			P REMOVED	19.00	5.8	D INFLIGHT NO ABORT	6.57	2.0
			Y TROUBLESHOOT	11.50	3.5	R QC CHECK	4.50	1.4
			X TEST-INSPECT-SERVICE	7.00	2.2	A BEFORE FLT ABORT	4.00	1.2
			L ADJUST	3.00	0.9	S DEPOT LEVEL MAINTNCE	1.30	0.4
						J PREFLIGHT	0.50	0.2
						K HOURLY POSTFLIGHT	0.33	0.1
170 CORRODED-MILD/MODRTE	311.78	1.6	Z CORROSION REPAIR	252.14	80.1	S DEPOT LEVEL MAINTNCE	159.40	50.3
			G RPR/RPLT MINOR PARTS	24.36	7.7	M PERIODIC/PHASED INSP	88.89	28.2
			V CLEAN	21.83	6.9	F BETWEEN FLT GND CREW	50.90	16.2
			P REMOVED	13.50	4.3	4 CORROSION CONTR INSP	7.42	2.4
			F REPAIR	2.00	0.6	H POST/THRUFLT	3.42	1.1
			R REMOVE AND REPLACE	0.70	0.2	Q SPECIAL INSPECTION	2.33	0.7
			X TEST-INSPECT-SERVICE	0.25	0.1	K HOURLY POSTFLIGHT	1.42	0.5
						D INFLIGHT NO ABORT	1.00	0.3
						R QC CHECK	1.00	0.3
303 BIRD STRIKE DAMAGE	274.05	1.4	L ADJUST	151.03	55.1	C INFLIGHT ABORT	236.05	86.1
			R REMOVE AND REPLACE	52.01	19.0	F BETWEEN FLT GND CREW	38.01	13.9
			A BNCH CK AND REPAIRED	30.01	11.0			
			F REPAIR	19.50	7.1			
			G RPR/RPLT MINOR PARTS	13.50	4.9			
			P REMOVED	6.00	2.2			
			Y TROUBLESHOOT	2.00	0.7			
190 CRACKED	248.29	1.3	G RPR/RPLT MINOR PARTS	104.41	42.1	F BETWEEN FLT GND CREW	185.93	74.9
			R REMOVE AND REPLACE	104.40	42.0	M PERIODIC/PHASED INSP	39.26	15.8
			P REMOVED	18.10	7.3	H POST/THRUFLT	11.50	4.6
			A BNCH CK AND REPAIRED	11.90	4.6	S DEPOT LEVEL MAINTNCE	6.00	2.4
			F REPAIR	6.67	2.7	B BEFORE FLT NO ABORT	4.00	1.6
			1 BNCH CK-NRTS-NOT ATH	2.30	0.9	R QC CHECK	1.00	0.4
			X TEST-INSPECT-SERVICE	0.50	0.2	D INFLIGHT NO ABORT	0.60	0.2
106 MISSING BOLTS,NUTS..	207.69	1.0	G RPR/RPLT MINOR PARTS	183.85	88.5	F BETWEEN FLT GND CREW	100.16	48.2
			A BNCH CK AND REPAIRED	11.80	5.7	M PERIODIC/PHASED INSP	72.04	34.7
			Q INSTALLED	7.83	3.8	H POST/THRUFLT	23.15	11.1
			Y TROUBLESHOOT	2.70	1.3	Q SPECIAL INSPECTION	4.33	2.1
			P REMOVED	1.00	0.5	K HOURLY POSTFLIGHT	3.50	1.7
			X TEST-INSPECT-SERVICE	0.50	0.2	B BEFORE FLT NO ABORT	2.00	1.0
						S DEPOT LEVEL MAINTNCE	1.50	0.7
						R QC CHECK	1.00	0.5
070 BROKEN	182.03	0.9	R REMOVE AND REPLACE	156.11	85.6	H POST/THRUFLT	145.78	80.1
			G RPR/RPLT MINOR PARTS	23.42	12.9	F BETWEEN FLT GND CREW	35.34	19.4

Figure A-1. F-4 Design/Cost MAMS (Continued)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

F-4 TRANSPARENCY WUCS ONAC AND SHOP 1/76-6/77 - MARSHALL STA 41-C3 MAR. 14, 1978 PAGE 11

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	544,662	470,536	$669,099	84,979.93	156.02

12320 FORWARD CANOPY ASSY (CONT.) — $141,771 LSC/YEAR; PCT OF LSC 21.19 TOTAL; LSC RNK 2; 19797.59 MAN HRS; PCT OF MHR 23.30 TOTAL; MHR RNK 2; 36.3184 MANHR /1000 FLT HR

HOW MAL FUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF WMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF WMC
			F REPAIR	1.93	1.0	M PERIODIC/PHASED INSP	0.50	0.3
			A BNCH CK AND REPAIRED	0.50	0.3	J PREFLIGHT	0.25	0.1
			Q INSTALLED	0.17	0.1	R QC CHECK	0.17	0.1
846 DELAMINATED	181.84	0.9	R REMOVE AND REPLACE	164.42	90.4	F BETWEEN FLT GND CREW	137.43	75.6
			P REMOVED	13.45	7.4	M PERIODIC/PHASED INSP	32.01	17.6
			1 BNCH CK-NRTS-NOT ATH	2.47	1.4	D INFLIGHT NO ABORT	12.40	6.8
			E INITIAL INSTALLATION	1.53	0.8			
730 LOOSE	116.71	0.6	L ADJUST	44.39	38.0	F BETWEEN FLT GND CREW	76.86	65.9
			G RPR/RPLT MINOR PARTS	37.72	32.3	H POST/THRUFLT	22.93	19.6
			P REMOVED	28.25	24.2	S DEPOT LEVEL MAINTNCE	7.40	6.3
			Y TROUBLESHOOT	4.60	3.9	M PERIODIC/PHASED INSP	6.68	5.7
			R REMOVE AND REPLACE	1.75	1.5	Q SPECIAL INSPECTION	1.83	1.6
						L TRAINING OR MAINTNCE	0.83	0.7
						R QC CHECK	0.17	0.1
520 PITTED	111.70	0.6	G RPR/RPLT MINOR PARTS	91.70	82.1	F BETWEEN FLT GND CREW	111.70	100.0
			P REMOVED	20.00	17.9			
381 LEAKING INT OR EXT	103.58	0.5	Y TROUBLESHOOT	57.07	55.1	F BETWEEN FLT GND CREW	65.57	63.3
			R REMOVE AND REPLACE	16.00	15.4	H POST/THRUFLT	16.00	15.4
			G RPR/RPLT MINOR PARTS	12.50	12.1	M PERIODIC/PHASED INSP	16.00	15.4
			L ADJUST	12.00	11.6	D INFLIGHT NO ABORT	4.50	4.3
			A BNCH CK AND REPAIRED	6.00	5.8	S DEPOT LEVEL MAINTNCE	1.50	1.4
750 MISSING	93.56	0.5	G RPR/RPLT MINOR PARTS	76.64	81.9	F BETWEEN FLT GND CREW	42.40	45.3
			Q INSTALLED	8.10	8.7	M PERIODIC/PHASED INSP	22.09	23.6
			Z CORROSION REPAIR	3.17	3.4	Q SPECIAL INSPECTION	16.17	17.3
			Y TROUBLESHOOT	2.25	2.4	H POST/THRUFLT	10.00	10.7
			F REPAIR	1.90	2.0	G GROUND ALERT-NOT DGR	1.90	2.0
			R REMOVE AND REPLACE	1.50	1.6	D INFLIGHT NO ABORT	0.70	0.7
						S DEPOT LEVEL MAINTNCE	0.30	0.3
93 DOES NOT ENGAGE/LOCK	77.50	0.4	Y TROUBLESHOOT	22.47	29.0	F BETWEEN FLT GND CREW	39.27	50.7
			L ADJUST	20.75	26.8	B BEFORE FLT NO ABORT	21.75	28.1
			P REMOVED	16.50	21.3	D INFLIGHT NO ABORT	10.30	13.3
			G RPR/RPLT MINOR PARTS	13.17	17.0	A BEFORE FLT ABORT	6.17	8.0
			X TEST-INSPECT-SERVICE	3.30	4.3			
			F REPAIR	1.30	1.7			
230 DIRTY CONTAM SATURAT	65.26	0.3	V CLEAN	49.42	74.2	F BETWEEN FLT GND CREW	23.00	35.2
			P REMOVED	6.00	9.2	M PERIODIC/PHASED INSP	13.58	20.8
			L ADJUST	4.00	6.1	L TRAINING OR MAINTNCE	9.50	14.6
			Y TROUBLESHOOT	4.00	6.1	J PREFLIGHT	8.60	13.2
			G RPR/RPLT MINOR PARTS	2.83	4.3	E AFTER FLIGHT	6.00	9.2
						Q SPECIAL INSPECTION	1.67	2.6
						H POST/THRUFLT	1.60	2.5

Figure A-1. F-4 Design/Cost MAMS (Continued)

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	544,662	470,536	$669,099	84,979.93	156.02

12320 FORWARD CANOPY ASSY (CONT.) — $141,771 LSC/YEAR; PCT OF LSC 21.19 TOTAL; LSC RNK 2; 19797.59 MAN HRS; PCT OF MHR 23.30 TOTAL; MHR RNK 2; 36.3384 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF MMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF MMC
						B BEFORE FLT NO ABORT	1.00	1.5
						R QC CHECK	0.30	0.5
108 BRK/MSG SAFETY WIRE	59.83	0.3	G RPR/RPLT MINOR PARTS	59.13	98.8	F BETWEEN FLT GND CREW	24.87	41.6
			X TEST-INSPECT-SERVICE	0.70	1.2	M PERIODIC/PHASED INSP	20.35	34.0
						S DEPOT LEVEL MAINTNCE	6.00	10.0
						Q SPECIAL INSPECTION	4.58	7.7
						K HOURLY POSTFLIGHT	2.50	4.2
						H POST/THRUFLT	1.10	1.8
						R QC CHECK	0.25	0.4
						D INFLIGHT NO ABORT	0.17	0.3
553 DOES NOT MEET SPEC	53.90	0.3	G RPR/RPLT MINOR PARTS	53.90	100.0	Y RECEIPT FROM STOCK	53.90	100.0
242 FAILED TO OPERATE	49.37	0.2	Y TROUBLESHOOT	45.17	91.5	F BETWEEN FLT GND CREW	41.00	83.0
			P REMOVED	2.20	4.5	D INFLIGHT NO ABORT	4.67	9.5
			L ADJUST	2.00	4.1	S DEPOT LEVEL MAINTNCE	2.20	4.5
						A BEFORE FLT ABORT	1.50	3.0
947 TORN	44.44	0.2	A BNCH CK AND REPAIRED	31.67	71.3	F BETWEEN FLT GND CREW	34.67	78.0
			G RPR/RPLT MINOR PARTS	6.57	14.6	M PERIODIC/PHASED INSP	7.07	15.9
			R REMOVE AND REPLACE	3.20	7.2	H POST/THRUFLT	2.00	4.5
			F REPAIR	3.00	6.8	Q SPECIAL INSPECTION	0.70	1.6
425 NICKED	42.33	0.2	P REMOVED	25.33	59.8	F BETWEEN FLT GND CREW	42.33	100.0
			V CLEAN	16.00	37.6			
			X TEST-INSPECT-SERVICE	1.00	2.4			
301 FOREIGN OBJ DAMAGE	41.96	0.2	P REMOVED	35.76	85.2	F BETWEEN FLT GND CREW	40.46	96.4
			Y TROUBLESHOOT	6.20	14.6	A BEFORE FLT ABORT	1.50	3.6
812 NO DEF-ASSOC EQP MAL	41.51	0.2	Q INSTALLED	24.00	57.6	F BETWEEN FLT GND CREW	33.51	80.7
			X TEST-INSPECT-SERVICE	9.50	22.9	J PREFLIGHT	6.00	14.5
			G RPR/RPLT MINOR PARTS	6.00	14.5	D INFLIGHT NO ABORT	2.00	4.9
			H EQUIP CK NO RPR RQRD	2.00	4.8			
386 MAINT DUE TO LOSTINF	32.00	0.2	Y TROUBLESHOOT	32.00	100.0	A BEFORE FLT ABORT	32.00	100.0
867 CORRODED-SEVERE	28.75	0.1	R REMOVE AND REPLACE	25.00	87.0	S DEPOT LEVEL MAINTNCE	25.00	87.0
			G RPR/RPLT MINOR PARTS	3.75	13.0	H POST/THRUFLT	3.75	13.0
865 PROT COAT/SEALNT DEF	26.67	0.1	G RPR/RPLT MINOR PARTS	25.87	97.0	F BETWEEN FLT GND CREW	19.20	72.0
			Z CORROSION REPAIR	0.80	3.0	S DEPOT LEVEL MAINTNCE	3.00	11.2
						M PERIODIC/PHASED INSP	2.97	11.1
						H POST/THRUFLT	1.50	5.6
561 UNABLE TO ADJ TO LMT	16.14	0.1	P REMOVED	14.84	91.9	F BETWEEN FLT GND CREW	15.84	98.1
			1 BNCH CK-NRTS-NOT ATH	1.30	8.1	Y RECEIPT FROM STOCK	0.30	1.9

Figure A-1. F-4 Design/Cost MAMS (Continued)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

F-4 TRANSPARENCY WUCS DNAC AND SHOP 1/76-6/77 - MARSHALL STA 11-C3 MAR. 14, 1978 PAGE 13

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	544,862	470,536	$669,059	84,979.93	156.02

12320 FORWARD CANOPY ASSY (CONT.) $141,771 LSC/YEAR | PCT OF LSC 21.19 TOTAL | LSC RNK 2 | 19797.59 MAN HRS | PCT OF MHR 23.30 TOTAL | MHR RNK 2 | 36.3184 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF HMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF HMC
004 NO DEF-SCH MAINT/MOD	16.00	0.1	P REMOVED	13.90	86.9	S DEPOT LEVEL MAINTNCE	16.00	100.0
			C BNCH CK-RPR DEFERRED	2.10	13.1			
955 DATA LINK ERROR	15.80	0.1	P REMOVED	15.80	100.0	F BETWEEN FLT GND CREW	15.80	100.0
117 DETERIORATED	15.39	0.1	G RPR/RPLT MINOR PARTS	9.13	59.3	M PERIODIC/PHASED INSP	7.75	50.4
			Q INSTALLED	6.25	40.6	F BETWEEN FLT GND CREW	6.80	44.2
						R QC CHECK	0.83	5.4
635 SENSITIVITY INCORR	15.34	0.1	R REMOVE AND REPLACE	15.34	100.0	D INFLIGHT NO ABORT	15.34	100.0
246 IMPROP/FAULTY MAINT	13.42	0.1	G RPR/RPLT MINOR PARTS	13.09	97.5	F BETWEEN FLT GND CREW	10.00	74.5
			Z CORROSION REPAIR	0.33	2.5	H POST/THRUFLT	2.00	14.9
						M PERIODIC/PHASED INSP	1.42	10.6
204 ACDT EXPLO MUNITIONS	11.00	0.1	R REMOVE AND REPLACE	11.00	100.0	C INFLIGHT ABORT	11.00	100.0
615 SHORTED	11.00	0.1	G RPR/RPLT MINOR PARTS	9.00	81.8	D INFLIGHT NO ABORT	9.00	81.8
			F REPAIR	2.00	18.2	F BETWEEN FLT GND CREW	2.00	18.2
003 NO DEF-TIME CHANGE	11.00	0.1	L ADJUST	11.00	100.0	C INFLIGHT ABORT	11.00	100.0
966 RF WINDOW BROKEN-CRK	10.00	0.1	P REMOVED	10.00	100.0	H POST/THRUFLT	10.00	100.0
450 OPEN	9.50	0.0	Y TROUBLESHOOT	5.20	54.7	B BEFORE FLT NO ABORT	9.50	100.0
			G RPR/RPLT MINOR PARTS	4.30	45.3			
410 LACK OF/IMPROPR LUBE	6.93	0.0	X TEST-INSPECT-SERVICE	5.52	79.7	M PERIODIC/PHASED INSP	3.17	45.7
			G RPR/RPLT MINOR PARTS	1.12	16.2	F BETWEEN FLT GND CREW	2.75	39.7
			F REPAIR	0.30	4.3	E AFTER FLIGHT	0.60	8.7
						K HOURLY POSTFLIGHT	0.42	6.1
005 NO DEF-NOC-OTH MAINT	6.00	0.0	P REMOVED	4.50	75.0	F BETWEEN FLT GND CREW	4.50	75.0
			S REMOVE AND REINSTALL	1.50	25.0	O INFLIGHT NO ABORT	1.50	25.0
585 SHEARED	5.50	0.0	P REMOVED	5.50	100.0	F BETWEEN FLT GND CREW	5.50	100.0
718 IMPROP RESP-MECH IPT	5.50	0.0	L ADJUST	3.00	54.5	B BEFORE FLT NO ABORT	3.00	54.5
			Y TROUBLESHOOT	2.50	45.5	D INFLIGHT NO ABORT	2.50	45.5
083 LOCK ON MALFUNCTION	5.00	0.0	Y TROUBLESHOOT	5.00	100.0	F BETWEEN FLT GND CREW	5.00	100.0
116 CUT	4.17	0.0	G RPR/RPLT MINOR PARTS	3.58	85.9	H POST/THRUFLT	2.67	64.0
			R REMOVE AND REPLACE	0.58	13.9	M PERIODIC/PHASED INSP	0.92	22.1
						S DEPOT LEVEL MAINTNCE	0.58	13.9
092 MISMATCHED PARTS	3.00	0.0	Y TROUBLESHOOT	3.00	100.0	H POST/THRUFLT	3.00	100.0

Figure A-1. F-4 Design/Cost MAMS (Continued)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

F-4 TRANSPARENCY WUCS ONAC AND SHOP 1/76-6/77 - MARSHALL STA 11-C3 MAR. 14, 1978 PAGE 14

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	544,662	470,506	$669,099	84,979.93	156.02

12.123 FORWARD CANOPY ASSY (CONT.) $141,771 LSC/YEAR | PCT OF LSC 21.19 TOTAL | LSC RNK 2 | 19797.59 MAN HRS | PCT OF MHR 23.30 TOTAL | MHR RNK 2 | 36.3484 MANHR /1000 FLT HR

HOW MALFUNCTION CODE	NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE	NAME	MAN HOURS	PERCENT OF HMC	WHEN DISCOVERED CODE	NAME	MAN HOURS	PERCENT OF HMC
710	BEARING FAILURE	3.00	0.0	P	REMOVED	3.00	100.0	F	BETWEEN FLT GND CREW	3.00	100.0
350	INSULATION BREAKDOWN	2.00	0.0	G	RPR/RPLT MINOR PARTS	2.00	100.0	F	BETWEEN FLT GND CREW	2.00	100.0
610	POOR OR INCORR FOCUS	1.80	0.0	Y	TROUBLESHOOT	1.80	100.0	R	QC CHECK	1.80	100.0
518	IMPROPER ROUTING	1.50	0.0	Q	INSTALLED	1.50	100.0	H	POST/THRUFLT	1.50	100.0
660	STRIPPED	1.00	0.0	G	RPR/RPLT MINOR PARTS	1.00	100.0	H	POST/THRUFLT	1.00	100.0
374	INTERNAL FAILURE	0.60	0.0	B	BNCH CK-RTN TO DEPOT	0.60	100.0	F	BETWEEN FLT GND CREW	0.60	100.0
719	BRK/FRYED BND/GND WR	0.50	0.0	G	RPR/RPLT MINOR PARTS	0.50	100.0	Q	SPECIAL INSPECTION	0.50	100.0
729	DECOUPLED	0.50	0.0	G	RPR/RPLT MINOR PARTS	0.50	100.0	M	PERIODIC/PHASED INSP	0.50	100.0

Figure A-1. F-4 Design/Cost MAMS (Continued)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

F-4 TRANSPARENCY WUCS ONAC AND SHOP 1/76-6/77 - MARSHALL STA 11-C3 MAR. 14, 1978 PAGE 15

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	544,662	470,536	$669,099	84,979.93	156.02

111AP W/S GLASS SIDE L-H $78,633 LSC/YEAR | PCT OF LSC 11.75 TOTAL | LSC RNK 3 | 10130.29 MAN HRS | PCT OF MHR 11.92 TOTAL | MHR RNK 3 | 18.5992 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF HMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF HMC
799 NO DEFECT	3463.71	34.2	Q INSTALLED	3291.21	95.0	F BETWEEN FLT GND CREW	2459.26	71.0
			P REMOVED	91.46	2.6	H POST/THRUFLT	663.32	19.2
			X TEST-INSPECT-SERVICE	45.41	1.3	D INFLIGHT NO ABORT	228.62	6.6
			H EQUIP CK NO RPR REQD	19.84	0.6	M PERIODIC/PHASED INSP	58.50	1.7
			G RPR/RPLT MINOR PARTS	15.80	0.5	R QC CHECK	28.01	0.8
						B BEFORE FLT NO ABORT	24.00	0.7
935 SCORED OR SCRATCHED	2741.92	27.1	R REMOVE AND REPLACE	1301.58	47.5	F BETWEEN FLT GND CREW	1963.32	71.6
			P REMOVED	1107.23	40.4	D INFLIGHT NO ABORT	226.13	8.2
			Q INSTALLED	155.03	5.7	H POST/THRUFLT	207.35	7.6
			G RPR/RPLT MINOR PARTS	153.15	5.6	S DEPOT LEVEL MAINTNCE	186.80	6.8
			V CLEAN	8.50	0.3	R QC CHECK	45.43	1.7
			X TEST-INSPECT-SERVICE	8.28	0.3	K HOURLY POSTFLIGHT	34.67	1.3
			Y TROUBLESHOOT	7.33	0.3	Q SPECIAL INSPECTION	28.50	1.0
			F REPAIR	0.80	0.0	J PREFLIGHT	26.01	0.9
						M PERIODIC/PHASED INSP	23.72	0.9
127 ADJMT/ALGNMT IMPROPR	1019.09	10.1	G RPR/RPLT MINOR PARTS	676.92	66.4	F BETWEEN FLT GND CREW	951.57	93.4
			L ADJUST	291.66	28.6	M PERIODIC/PHASED INSP	38.84	3.8
			A BNCH CK AND REPAIRED	18.67	1.8	H POST/THRUFLT	19.30	1.9
			F REPAIR	16.00	1.6	D INFLIGHT NO ABORT	7.30	0.7
			Q INSTALLED	15.84	1.6	K HOURLY POSTFLIGHT	2.08	0.2
605 CRAZED	872.19	8.6	R REMOVE AND REPLACE	367.29	42.1	F BETWEEN FLT GND CREW	586.11	67.2
			P REMOVED	231.62	26.6	D INFLIGHT NO ABORT	85.01	9.7
			G RPR/RPLT MINOR PARTS	189.77	21.8	M PERIODIC/PHASED INSP	74.51	8.5
			Q INSTALLED	71.09	8.2	H POST/THRUFLT	66.30	7.6
			L ADJUST	9.17	1.1	S DEPOT LEVEL MAINTNCE	60.00	6.9
			X TEST-INSPECT-SERVICE	3.25	0.4	R QC CHECK	0.25	0.0
910 CHIPPED	393.40	3.9	P REMOVED	170.42	43.3	F BETWEEN FLT GND CREW	238.16	60.5
			R REMOVE AND REPLACE	106.16	27.0	H POST/THRUFLT	96.19	24.5
			Q INSTALLED	83.84	21.3	A BEFORE FLT ABORT	29.00	7.4
			G RPR/RPLT MINOR PARTS	20.97	5.3	M PERIODIC/PHASED INSP	20.05	5.1
			Y TROUBLESHOOT	11.00	2.8	P FUNCTIONAL CK FLT	10.00	2.5
			X TEST-INSPECT-SERVICE	1.00	0.3			
780 BENT,BUCKLED,COLLASP	322.04	3.2	R REMOVE AND REPLACE	195.21	60.6	F BETWEEN FLT GND CREW	272.03	84.5
			P REMOVED	78.42	24.4	D INFLIGHT NO ABORT	45.01	14.0
			Q INSTALLED	30.01	9.3	M PERIODIC/PHASED INSP	4.00	1.2
			G RPR/RPLT MINOR PARTS	17.90	5.6	H POST/THRUFLT	1.00	0.3
			X TEST-INSPECT-SERVICE	0.50	0.2			
190 CRACKED	295.77	2.9	G RPR/RPLT MINOR PARTS	172.71	58.4	F BETWEEN FLT GND CREW	200.21	67.7
			Q INSTALLED	43.51	14.7	D INFLIGHT NO ABORT	51.81	17.5
			P REMOVED	35.30	11.9	H POST/THRUFLT	32.01	10.8
			R REMOVE AND REPLACE	23.00	7.8	E AFTER FLIGHT	6.00	2.0

Figure A-1. F-4 Design/Cost MAMS (Continued)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

F 4 TRANSPARENCY WUCS ONAC AND SHOP 1/76-6/77 - MARSHALL STA 11-03 MAR. 14, 1978 PAGE 16

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	544,662	470,536	$669,099	84,979.93	156.02

111AP W/S GLASS SIDE L-H (CONT.) $78,633 LSC/YEAR | PCT OF LSC 11.75 TOTAL | LSC RNK 3 | 10130.29 MAN HRS | PCT OF MHR 11.92 TOTAL | MHR RNK 3 | 18.5092 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF HMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF HMC
			A BNCH CK AND REPAIRED	20.25	6.6	1	5.25	1.8
			X TEST-INSPECT-SERVICE	1.00	0.3	M PERIODIC/PHASED INSP	0.50	0.2
105 LOOSE/DMGD BOLTS,NUT	223.54	2.2	G RPR/RPLT MINOR PARTS	214.12	95.8	F BETWEEN FLT GND CREW	147.82	66.1
			R REMOVE AND REPLACE	5.50	2.5	H POST/THRUFLT	48.17	21.5
			A BNCH CK AND REPAIRED	3.42	1.5	M PERIODIC/PHASED INSP	9.28	4.2
			L ADJUST	0.40	0.2	J PREFLIGHT	8.75	3.9
			Q INSTALLED	0.10	0.0	D INFLIGHT NO ABORT	7.42	3.3
						R QC CHECK	2.00	0.9
						S DEPOT LEVEL MAINTNCE	0.10	0.0
846 DELAMINATED	206.86	2.0	R REMOVE AND REPLACE	129.02	62.4	F BETWEEN FLT GND CREW	188.02	90.9
			P REMOVED	66.00	31.9	S DEPOT LEVEL MAINTNCE	9.00	4.4
			G RPR/RPLT MINOR PARTS	11.00	5.3	D INFLIGHT NO ABORT	7.00	3.4
			Y TROUBLESHOOT	0.83	0.4	J PREFLIGHT	2.00	1.0
						H POST/THRUFLT	0.83	0.4
800 NO DEF-RMVD-OTH MAINT	91.36	0.9	P REMOVED	34.00	37.2	F BETWEEN FLT GND CREW	84.30	92.3
			Q INSTALLED	30.30	33.2	Q SPECIAL INSPECTION	4.00	4.4
			S REMOVE AND REINSTALL	27.05	29.6	D INFLIGHT NO ABORT	2.30	2.5
						H POST/THRUFLT	0.50	0.5
						P FUNCTIONAL CK FLT	0.25	0.3
381 LEAKING INT OR EXT	81.01	0.8	G RPR/RPLT MINOR PARTS	51.01	63.0	F BETWEEN FLT GND CREW	73.01	90.1
			R REMOVE AND REPLACE	16.00	19.8	R QC CHECK	8.00	9.9
			Q INSTALLED	14.00	17.3			
520 PITTED	72.90	0.7	G RPR/RPLT MINOR PARTS	39.64	54.4	F BETWEEN FLT GND CREW	40.14	55.1
			R REMOVE AND REPLACE	32.76	44.9	D INFLIGHT NO ABORT	32.76	44.9
			Y TROUBLESHOOT	0.50	0.7			
425 NICKED	58.41	0.6	P REMOVED	52.24	89.4	F BETWEEN FLT GND CREW	38.74	66.3
			G RPR/RPLT MINOR PARTS	6.17	10.6	D INFLIGHT NO ABORT	13.50	23.1
						M PERIODIC/PHASED INSP	6.17	10.6
106 MISSING BOLTS,NUTS..	57.19	0.6	G RPR/RPLT MINOR PARTS	42.35	74.1	F BETWEEN FLT GND CREW	53.04	92.7
			C BNCH CK-RPR DEFERRED	8.67	15.2	H POST/THRUFLT	3.00	5.2
			F REPAIR	6.17	10.8	M PERIODIC/PHASED INSP	1.15	2.0
070 BROKEN	40.10	0.4	G RPR/RPLT MINOR PARTS	30.10	75.1	F BETWEEN FLT GND CREW	40.10	100.0
			P REMOVED	10.00	24.9			
020 WORN CHAFED OR FRAYD	38.34	0.4	P REMOVED	24.50	63.9	F BETWEEN FLT GND CREW	30.00	78.2
			G RPR/RPLT MINOR PARTS	13.84	36.1	H POST/THRUFLT	8.33	21.7
303 BIRD STRIKE DAMAGE	29.50	0.3	P REMOVED	25.50	86.4	F BETWEEN FLT GND CREW	18.50	62.7
			G RPR/RPLT MINOR PARTS	2.50	8.5	C INFLIGHT ABORT	11.00	37.3
			X TEST-INSPECT-SERVICE	1.50	5.1			

Figure A-1. F-4 Design/Cost MAMS (Continued)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

F-4 TRANSPARENCY WUCS ONAC . NO SHOP 1/76-6/77 - MARSHALL STA 11-C3 MAR. 14, 1978 PAGE 17

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	544,662	470,536	$869,099	84,973.93	156.02

11:AP W/S GLASS SIDE L-H (CONT.) $78,633 LSC/YEAR | PCT OF LSC 11.75 TOTAL | LSC RNK 3 | 10130.29 MAN HRS | PCT OF MHR 11.92 TOTAL | MHR RNK 3 | 18.5992 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF HMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF HMC
135 BINDING,STUCK,JAMMED	24.00	0.2	P REMOVED	24.00	100.0	F BETWEEN FLT GND CREW	24.00	100.0
615 SHORTED	22.25	0.2	P REMOVED	22.25	100.0	F BETWEEN FLT GND CREW	22.25	100.0
730 LOOSE	18.84	0.2	Q INSTALLED	15.34	81.4	H POST/THRUFLT	17.34	92.0
			G RPR/RPLT MINOR PARTS	2.30	12.2	F BETWEEN FLT GND CREW	1.20	6.4
			L ADJUST	1.20	6.4	S DEPOT LEVEL MAINTNCE	0.30	1.6
865 PROT COAT/SEALNT DEF	17.17	0.2	G RPR/RPLT MINOR PARTS	15.00	87.4	F BETWEEN FLT GND CREW	17.17	100.0
			Q INSTALLED	2.17	12.6			
230 DIRTY CONTAM SATURAT	8.97	0.1	V CLEAN	5.97	66.6	H POST/THRUFLT	3.00	33.4
			R REMOVE AND REPLACE	2.00	22.3	S DEPOT LEVEL MAINTNCE	2.50	27.9
			F REPAIR	0.50	5.6	M PERIODIC/PHASED INSP	1.80	20.1
			P REMOVED	0.50	5.6	D INFLIGHT NO ABORT	1.00	11.1
						F BETWEEN FLT GND CREW	0.67	7.5
750 MISSING	8.60	0.1	Q INSTALLED	6.30	73.3	M PERIODIC/PHASED INSP	6.30	73.3
			G RPR/RPLT MINOR PARTS	2.30	26.7	F BETWEEN FLT GND CREW	2.30	26.7
639 POTTING MATL MELTING	7.00	0.1	G RPR/RPLT MINOR PARTS	7.00	100.0	F BETWEEN FLT GND CREW	7.00	100.0
301 FOREIGN OBJ DAMAGE	6.00	0.1	P REMOVED	6.00	100.0	F BETWEEN FLT GND CREW	6.00	100.0
170 CORRODED-MILD/MODRTE	4.92	0.0	Z CORROSION REPAIR	4.92	100.0	S DEPOT LEVEL MAINTNCE	2.00	40.7
						4 CORROSION CONTR INSP	2.00	40.7
						M PERIODIC/PHASED INSP	0.92	18.7
947 TORN	2.40	0.0	G RPR/RPLT MINOR PARTS	2.40	100.0	K HOURLY POSTFLIGHT	2.00	83.3
						M PERIODIC/PHASED INSP	0.40	16.7
117 DETERIORATED	1.50	0.0	G RPR/RPLT MINOR PARTS	1.00	66.7	M PERIODIC/PHASED INSP	1.00	66.7
			R REMOVE AND REPLACE	0.50	33.3	R QC CHECK	0.50	33.3
108 BRK/MSG SAFETY WIRE	0.75	0.0	G RPR/RPLT MINOR PARTS	0.75	100.0	K HOURLY POSTFLIGHT	0.75	100.0
680 STRIPPED	0.50	0.0	G RPR/RPLT MINOR PARTS	0.50	100.0	M PERIODIC/PHASED INSP	0.50	100.0
246 IMPROP/FAULTY MAINT	0.08	0.0	R REMOVE AND REPLACE	0.08	100.0	H POST/THRUFLT	0.08	100.0

Figure A-1. F-4 Design/Cost MAMS (Continued)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

F-4 TRANSPARENCY W/C1 ONAC AND SHOP 1/76-6/77 - MARSHALL STA 11-C3 MAR. 14, 1978 PAGE 18

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	544,662	470,536	$669,099	84,979.93	156.02

111AN W/S GLASS SIDE R-H $72,093 LSC/YEAR | PCT OF LSC 10.77 TOTAL | LSC RNK 4 | 17114.46 MAN HRS | PCT OF MHR 11.90 TOTAL | MHR RNK 1 | 18.5701 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF MDC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF MMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF MMC
799 NO DEFECT	3116.98	30.8	Q INSTALLED	2949.35	94.6	F BETWEEN FLT GND CREW	2662.10	85.4
			G RPR/RPLT MINOR PARTS	87.68	2.8	H POST/THRUFLT	232.86	7.5
			X TEST-INSPECT-SERVICE	40.09	1.3	D INFLIGHT NO ABORT	105.18	3.4
			H EQUIP CK NO RPR RQRD	20.10	0.6	M PERIODIC/PHASED INSP	57.22	1.8
			P REMOVED	17.75	0.6	Q SPECIAL INSPECTION	20.60	0.7
			R REMOVE AND REPLACE	2.00	0.1	K HOURLY POSTFLIGHT	19.50	0.6
						R QC CHECK	19.50	0.6
935 SCORED OR SCRATCHED	2638.24	26.1	R REMOVE AND REPLACE	1205.14	45.7	F BETWEEN FLT GND CREW	1795.59	68.1
			P REMOVED	1064.37	40.3	S DEPOT LEVEL MAINTNCE	373.10	14.1
			G RPR/RPLT MINOR PARTS	160.90	6.1	H POST/THRUFLT	194.21	7.4
			Q INSTALLED	156.53	5.9	D INFLIGHT NO ABORT	94.02	3.6
			X TEST-INSPECT-SERVICE	18.75	0.7	M PERIODIC/PHASED INSP	85.48	3.2
			A BNCH CK AND REPAIRED	15.00	0.6	A BEFORE FLT ABORT	48.01	1.8
			V CLEAN	10.55	0.4	E AFTER FLIGHT	15.50	0.6
			Y TROUBLESHOOT	5.70	0.2	K HOURLY POSTFLIGHT	13.84	0.5
			F REPAIR	1.40	0.1	Q SPECIAL INSPECTION	6.50	0.2
						P FUNCTIONAL CK FLT	6.00	0.2
						L TRAINING OR MAINTNCE	5.00	0.2
						G GROUND ALERT-NOT DGR	1.00	0.0
605 CRAZED	1178.54	11.7	R REMOVE AND REPLACE	559.16	47.4	F BETWEEN FLT GND CREW	640.01	54.3
			P REMOVED	288.48	24.5	S DEPOT LEVEL MAINTNCE	156.10	13.2
			G RPR/RPLT MINOR PARTS	228.45	19.4	D INFLIGHT NO ABORT	144.11	12.2
			Q INSTALLED	82.03	7.0	H POST/THRUFLT	143.84	12.2
			A BNCH CK AND REPAIRED	13.00	1.1	M PERIODIC/PHASED INSP	80.56	6.8
			X TEST-INSPECT-SERVICE	4.42	0.4	K HOURLY POSTFLIGHT	11.00	0.9
			Y TROUBLESHOOT	3.00	0.3	G GROUND ALERT-NOT DGR	2.67	0.2
						R QC CHECK	0.25	0.0
127 ADJMT/ALGNMT IMPROPR	704.38	7.0	G RPR/RPLT MINOR PARTS	489.34	69.3	F BETWEEN FLT GND CREW	641.28	91.0
			L ADJUST	175.41	24.9	H POST/THRUFLT	36.31	5.2
			A BNCH CK AND REPAIRED	29.80	4.2	M PERIODIC/PHASED INSP	26.80	3.8
			F REPAIR	9.00	1.3			
			R REMOVE AND REPLACE	1.83	0.3			
780 BENT,BUCKLED,COLLASP	528.71	5.2	R REMOVE AND REPLACE	415.14	78.5	F BETWEEN FLT GND CREW	406.64	76.9
			P REMOVED	111.26	21.0	D INFLIGHT NO ABORT	76.27	14.4
			F REPAIR	1.50	0.3	S DEPOT LEVEL MAINTNCE	45.80	8.7
			G RPR/RPLT MINOR PARTS	0.80	0.2			
190 CRACKED	394.34	3.9	P REMOVED	154.75	39.2	F BETWEEN FLT GND CREW	339.25	86.0
			G RPR/RPLT MINOR PARTS	150.16	38.1	D INFLIGHT NO ABORT	26.01	6.6
			R REMOVE AND REPLACE	50.51	12.8	M PERIODIC/PHASED INSP	25.34	6.4
			Q INSTALLED	28.01	7.1	Q SPECIAL INSPECTION	2.25	0.6
			A BNCH CK AND REPAIRED	9.42	2.4	H POST/THRUFLT	1.50	0.4
			X TEST-INSPECT-SERVICE	1.50	0.4			

Figure A-1. F-4 Design/Cost MAMS (Continued)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

F-4 TRANSPARENCY WUCS ONAC AND SHOP 1/76-6/77 - MARSHALL STA 11-C3 MAR. 14, 1978 PAGE 19

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	544,662	170,536	$669,099	84,970.93	156.02

111AN W/S GLASS SIDE R-H (CONT.) $72,093 LSC/YEAR | PCT OF LSC TOTAL 10.77 | LSC RNK 4 | 10114.46 MAN HRS | PCT OF MHR TOTAL 11.90 | MHR RNK 4 | 18.5701 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF HMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF HMC
105 LOOSE/DMGD BOLTS,NUT	357.11	3.5	G RPR/RPLT MINOR PARTS	341.53	95.6	F BETWEEN FLT GND CREW	238.62	66.8
			L ADJUST	8.25	2.3	H POST/1HRUFLT	92.39	25.9
			A BNCH CK AND REPAIRED	4.00	1.1	M PERIODIC/PHASED INSP	14.60	4.1
			R REMOVE AND REPLACE	2.33	0.7	D INFLIGHT NO ABORT	6.20	1.7
			X TEST-INSPECT-SERVICE	1.00	0.3	S DEPOT LEVEL MAINTNCE	3.30	0.9
						K HOURLY POSTFLIGHT	2.00	0.6
910 CHIPPED	192.60	1.9	R REMOVE AND REPLACE	106.77	55.4	F BETWEEN FLT GND CREW	98.78	51.3
			G RPR/RPLT MINOR PARTS	43.57	22.6	H POST/1HRUFLT	85.52	44.4
			P REMOVED	24.00	12.5	C INFLIGHT ABORT	4.25	2.2
			Q INSTALLED	18.00	9.3	S DEPOT LEVEL MAINTNCE	2.00	1.0
			X TEST-INSPECT-SERVICE	0.25	0.1	M PERIODIC/PHASED INSP	1.80	0.9
						R QC CHECK	0.25	0.1
848 DELAMINATED	158.74	1.6	P REMOVED	82.23	51.8	F BETWEEN FLT GND CREW	147.74	93.1
			R REMOVE AND REPLACE	48.68	30.7	S DEPOT LEVEL MAINTNCE	10.50	6.6
			G RPR/RPLT MINOR PARTS	15.84	10.0	M PERIODIC/PHASED INSP	0.50	0.3
			Q INSTALLED	12.00	7.6			
900 NO DEF-RMVD-OTH MAINT	127.12	1.3	P REMOVED	65.31	51.4	F BETWEEN FLT GND CREW	115.12	90.6
			Q INSTALLED	49.81	39.2	H POST/1HRUFLT	12.00	9.4
			R REMOVE AND REPLACE	6.00	4.7			
			S REMOVE AND REINSTALL	6.00	4.7			
391 LEAKING INT OR EXT	110.21	1.1	G RPR/RPLT MINOR PARTS	67.71	61.4	F BETWEEN FLT GND CREW	66.21	60.1
			Y TROUBLESHOOT	36.50	33.1	D INFLIGHT NO ABORT	33.50	30.4
			Q INSTALLED	6.00	5.4	H POST/1HRUFLT	9.50	8.6
						S DEPOT LEVEL MAINTNCE	1.00	0.9
070 BROKEN	90.06	0.9	R REMOVE AND REPLACE	40.01	44.4	F BETWEEN FLT GND CREW	81.06	90.0
			G RPR/RPLT MINOR PARTS	28.76	31.9	R QC CHECK	7.00	7.8
			A BNCH CK AND REPAIRED	13.00	14.4	H POST/1HRUFLT	2.00	2.2
			P REMOVED	8.00	8.9			
			1 BNCH CK-NRTS-NOT ATH	0.30	0.3			
425 NICKED	86.50	0.9	P REMOVED	59.70	69.0	F BETWEEN FLT GND CREW	50.00	57.8
			R REMOVE AND REPLACE	14.00	16.2	H POST/1HRUFLT	18.30	21.2
			X TEST-INSPECT-SERVICE	4.50	5.2	D INFLIGHT NO ABORT	18.20	21.0
			Y TROUBLESHOOT	4.30	5.0			
			G RPR/RPLT MINOR PARTS	4.00	4.6			
520 PITTED	78.42	0.8	R REMOVE AND REPLACE	60.00	76.5	S DEPOT LEVEL MAINTNCE	60.00	76.5
			G RPR/RPLT MINOR PARTS	17.42	22.2	F BETWEEN FLT GND CREW	16.92	21.6
			X TEST-INSPECT-SERVICE	1.00	1.3	H POST/1HRUFLT	1.50	1.9
108 MISSING BOLTS,NUTS..	74.34	0.7	G RPR/RPLT MINOR PARTS	68.01	91.5	F BETWEEN FLT GND CREW	52.77	71.0
			A BNCH CK AND REPAIRED	3.00	4.0	M PERIODIC/PHASED INSP	10.30	13.9

Figure A-1. F-4 Design/Cost MAMS (Continued)

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	544,662	470,536	$689,099	84,979.93	156.02

111AN W/S GLASS SIDE R-H (CONT.) — $72,093 LSC/YEAR; PCT OF LSC 10.77 TOTAL; LSC RNK 4; 10114.46 MAN HRS; PCT OF MHR 11.90 TOTAL; MHR RNK 4; 18.5701 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF HMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF HMC
			Q INSTALLED	6.00	4.0	N POST/THRUFLT	8.97	12.1
			X TEST-INSPECT-SERVICE	0.33	0.4	S DEPOT LEVEL MAINTNCE	2.00	2.7
						R QC CHECK	0.30	0.4
020 WORN CHAFED OR FRAYD	49.26	0.5	G RPR/RPLT MINOR PARTS	39.26	80.0	F BETWEEN FLT GND CREW	41.59	84.7
			A BNCH CK AND REPAIRED	6.83	13.9	P FUNCTIONAL CK FLT	3.00	6.1
			R REMOVE AND REPLACE	3.00	6.1	M PERIODIC/PHASED INSP	2.00	4.1
						S DEPOT LEVEL MAINTNCE	2.00	4.1
						H POST/THRUFLT	0.50	1.0
552 DOES NOT MEET SPEC	39.00	0.4	Q INSTALLED	20.00	51.3	Y RECEIPT FROM STOCK	39.00	100.0
			G RPR/RPLT MINOR PARTS	19.00	48.7			
117 DETERIORATED	37.20	0.4	G RPR/RPLT MINOR PARTS	25.00	67.2	F BETWEEN FLT GND CREW	35.70	96.0
			P REMOVED	12.20	32.8	M PERIODIC/PHASED INSP	1.50	4.0
865 PROT COAT/SEALNT DEF	24.72	0.2	G RPR/RPLT MINOR PARTS	18.72	75.7	F BETWEEN FLT GND CREW	23.42	94.7
			R REMOVE AND REPLACE	6.00	24.3	H POST/THRUFLT	1.00	4.0
						S DEPOT LEVEL MAINTNCE	0.30	1.2
230 DIRTY CONTAM SATURAT	20.92	0.2	V CLEAN	18.92	90.4	L TRAINING OR MAINTNCE	9.50	45.4
			F REPAIR	1.50	7.2	H POST/THRUFLT	6.00	28.7
			Z CORROSION REPAIR	0.50	2.4	D INFLIGHT NO ABORT	2.08	9.9
						S DEPOT LEVEL MAINTNCE	1.50	7.2
						M PERIODIC/PHASED INSP	1.00	4.8
						F BETWEEN FLT GND CREW	0.83	4.0
730 LOOSE	16.55	0.2	G RPR/RPLT MINOR PARTS	15.39	93.0	H POST/THRUFLT	9.50	57.4
			L ADJUST	1.17	7.1	F BETWEEN FLT GND CREW	6.25	37.8
						M PERIODIC/PHASED INSP	0.80	4.8
615 SHORTED	16.00	0.2	P REMOVED	16.00	100.0	F BETWEEN FLT GND CREW	16.00	100.0
150 CHATTERING	12.00	0.1	R REMOVE AND REPLACE	12.00	100.0	F BETWEEN FLT GND CREW	12.00	100.0
303 BIRD STRIKE DAMAGE	10.25	0.1	P REMOVED	10.25	100.0	F BETWEEN FLT GND CREW	10.25	100.0
947 TORN	9.50	0.1	R REMOVE AND REPLACE	7.50	78.9	F BETWEEN FLT GND CREW	9.50	100.0
			Y TROUBLESHOOT	2.00	21.1			
623 AFTERBURNER BLOWOUT	9.00	0.1	G RPR/RPLT MINOR PARTS	9.00	100.0	F BETWEEN FLT GND CREW	9.00	100.0
955 DATA LINK ERROR	7.50	0.1	P REMOVED	7.50	100.0	K HOURLY POSTFLIGHT	7.50	100.0
782 TIRE TREAD DEFECTIVE	7.00	0.1	R REMOVE AND REPLACE	7.00	100.0	F BETWEEN FLT GND CREW	7.00	100.0
609 OUT OF TRACK	6.00	0.1	L ADJUST	6.00	100.0	H POST/THRUFLT	6.00	100.0

Figure A-1. F-4 Design/Cost MAMS (Continued)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

F-4 TRANSPARENCY WUCS ONAC AND SHOP 1/76-6/77 - MARSHALL STA 11-C3 MAR. 14, 1978 PAGE 21

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	544,662	470,536	$669,099	84,979.93	156.02

111AN W/S GLASS SIDE R-H $72,093 LSC/YEAR PCT OF LSC 10.77 LSC RNK TOTAL 4 10114.46 MAN HRS PCT OF MHR 11.90 MHR RNK TOTAL 4 18.5701 MANHR /1000 FLT HR

(CONT.)

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF HMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF HMC
750 MISSING	4.00	0.0	G RPR/RPLT MINOR PARTS	4.00	100.0	M PERIODIC/PHASED INSP	4.00	100.0
170 CORRODED-MILD/MODRTE	3.50	0.0	Z CORROSION REPAIR	3.50	100.0	S DEPOT LEVEL MAINTNCE	3.00	85.7
						M PERIODIC/PHASED INSP	0.50	14.3
660 STRIPPED	3.50	0.0	G RPR/RPLT MINOR PARTS	3.50	100.0	F BETWEEN FLT GND CREW	3.50	100.0
108 BRK/MSG SAFETY WIRE	1.83	0.0	G RPR/RPLT MINOR PARTS	1.83	100.0	H POST/THRUFLT	1.83	100.0
246 IMPROP/FAULTY MAINT	0.58	0.0	G RPR/RPLT MINOR PARTS	0.50	86.2	M PERIODIC/PHASED INSP	0.50	86.2
			R REMOVE AND REPLACE	0.08	13.8	H POST/THRUFLT	0.08	13.8

Figure A-1. F-4 Design/Cost MAMS (Continued)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

F-4 TRANSPARENCY WUCS ONAC AND SHOP 1/76-6/77 - MARSHALL SYA 11-03 MAR. 14, 1978 PAGE 22

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	541,662	470,536	$669,099	84,979.93	156.02

111AQ W/S PANEL FLAT CENTR $70,500 LSC/YEAR | PCT OF LSC 10.54 TOTAL | LSC RNK 5 | 8875.43 MAN HRS | PCT OF MHR 10.44 TOTAL | MHR RNK 5 | 16.2953 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF HMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF HMC
799 NO DEFECT	2921.49	32.9	Q INSTALLED	2648.00	90.6	F BETWEEN FLT GND CREW	2485.51	85.1
			X TEST-INSPECT-SERVICE	153.37	5.2	D INFLIGHT NO ABORT	274.47	9.4
			H EQUIP CK NO RPR RQRD	40.47	1.4	C INFLIGHT ABORT	67.20	2.3
			G RPR/RPLT MINOR PARTS	31.34	1.1	H POST/THRUFLT	48.10	1.6
			P REMOVED	19.53	0.7	M PERIODIC/PHASED INSP	33.70	1.2
			T REMOVE FOR CANIBLZTN	15.60	0.5	Q SPECIAL INSPECTION	11.00	0.4
			U RPLCD AFTER CANBLZTN	9.00	0.3	R QC CHECK	1.50	0.1
			L ADJUST	3.17	0.1			
			R REMOVE AND REPLACE	1.00	0.0			
190 CRACKED	2626.75	29.6	R REMOVE AND REPLACE	1215.96	46.3	F BETWEEN FLT GND CREW	1712.33	65.2
			P REMOVED	921.96	35.1	D INFLIGHT NO ABORT	450.89	17.2
			Q INSTALLED	238.20	9.1	C INFLIGHT ABORT	173.18	6.6
			G RPR/RPLT MINOR PARTS	168.99	6.4	E AFTER FLIGHT	123.50	4.7
			A BNCH CK AND REPAIRED	34.64	1.3	M PERIODIC/PHASED INSP	53.51	2.0
			C BNCH CK-RPR DEFERRED	29.01	1.1	J PREFLIGHT	51.84	2.0
			L ADJUST	15.00	0.6	A BEFORE FLT ABORT	37.50	1.4
			F REPAIR	3.80	0.1	H POST/THRUFLT	23.00	0.9
						S DEPOT LEVEL MAINTNCE	1.00	0.0
331 LEAKING INT OR EXT	532.97	6.0	G RPR/RPLT MINOR PARTS	211.35	39.7	F BETWEEN FLT GND CREW	473.21	88.8
			P REMOVED	208.06	39.0	D INFLIGHT NO ABORT	41.26	7.7
			L ADJUST	43.80	8.2	H POST/THRUFLT	12.00	2.3
			X TEST-INSPECT-SERVICE	34.26	6.4	S DEPOT LEVEL MAINTNCE	4.50	0.8
			R REMOVE AND REPLACE	24.50	4.6	J PREFLIGHT	2.00	0.4
			Y TROUBLESHOOT	11.00	2.1			
105 LOOSE/DMGD BOLTS,NUT	407.67	4.6	G RPR/RPLT MINOR PARTS	397.79	97.6	F BETWEEN FLT GND CREW	280.76	68.9
			A BNCH CK AND REPAIRED	7.08	1.7	H POST/THRUFLT	45.94	11.3
			Y TROUBLESHOOT	1.25	0.3	D INFLIGHT NO ABORT	37.75	9.3
			L ADJUST	0.80	0.2	M PERIODIC/PHASED INSP	26.02	6.4
			Q INSTALLED	0.75	0.2	Q SPECIAL INSPECTION	13.20	3.2
						S DEPOT LEVEL MAINTNCE	2.30	0.6
						J PREFLIGHT	1.70	0.4
935 SCORED OR SCRATCHED	374.94	4.2	R REMOVE AND REPLACE	275.37	73.4	F BETWEEN FLT GND CREW	262.18	69.9
			P REMOVED	77.77	20.7	S DEPOT LEVEL MAINTNCE	60.00	16.0
			Q INSTALLED	20.80	5.5	H POST/THRUFLT	28.26	7.5
			X TEST-INSPECT-SERVICE	1.00	0.3	D INFLIGHT NO ABORT	24.00	6.4
						Q SPECIAL INSPECTION	0.50	0.1
846 DELAMINATED	369.38	4.2	R REMOVE AND REPLACE	160.85	46.0	F BETWEEN FLT GND CREW	220.70	59.7
			P REMOVED	143.99	40.3	H POST/THRUFLT	79.18	21.4
			G RPR/RPLT MINOR PARTS	34.84	9.2	S DEPOT LEVEL MAINTNCE	62.00	16.8
			Q INSTALLED	17.00	4.6	D INFLIGHT NO ABORT	7.50	2.0
910 CHIPPED	178.39	2.0	P REMOVED	82.31	46.1	F BETWEEN FLT GND CREW	132.56	74.3

Figure A-1. F-4 Design/Cost MAMS (Continued)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

F-4 TRANSPARENCY W/CS GNAC AND SYSP 1/76-6/77 - MARSHALL STA 11-CG MAR. 14, 1978 PAGE 23

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	544,662	470,535	$660,699	84,979.93	156.02

1111AQ W/S PANEL FLAT CENTR (CONT.) $70,500 LSC/YEAR | PCT OF LSC TOTAL 10.54 | LSC RNK 5 | 8875.43 MAN HRS | PCT OF MHR TOTAL 10.44 | MHR RNK 5 | 16.2953 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF MMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF MMC
			Q INSTALLED	56.00	31.4	U PREFLIGHT	37.60	21.2
			R REMOVE AND REPLACE	30.92	17.3	H POST/1HRUFLT	8.00	4.5
			G RPR/RPLT MINOR PARTS	8.67	4.9			
			X TEST-INSPECT-SERVICE	0.50	0.3			
520 PITTED	178.37	2.0	R REMOVE AND REPLACE	134.36	75.3	F BETWEEN FLT GND CREW	102.89	57.6
			S REMOVED	29.00	16.3	D INFLIGHT NO ABORT	72.76	40.8
			G RPR/RPLT MINOR PARTS	15.00	8.4	P FUNCTIONAL CK FLT	2.92	1.6
866 PROT COAT/SEALNT DEF	151.58	1.7	G RPR/RPLT MINOR PARTS	98.07	64.7	F BETWEEN FLT GND CREW	136.49	90.0
			Q INSTALLED	32.57	21.6	D INFLIGHT NO ABORT	5.00	3.3
			V CLEAN	15.84	10.4	H POST/1HRUFLT	5.00	3.3
			L ADJUST	4.00	2.6	M PERIODIC/PHASED INSP	2.50	1.6
			R REMOVE AND REPLACE	1.00	0.7	K HOURLY POSTFLIGHT	1.58	1.0
						J PREFLIGHT	1.00	0.7
020 WORN CHAFED OR FRAYD	136.15	1.5	R REMOVE AND REPLACE	130.85	96.1	S DEPOT LEVEL MAINTNCE	70.00	51.4
			G RPR/RPLT MINOR PARTS	4.30	3.2	F BETWEEN FLT GND CREW	64.85	47.6
			K TEST-INSPECT-SERVICE	1.00	0.7	H POST/1HRUFLT	1.30	1.0
800 NO DEF-RMVD-OTH MAINT	126.22	1.4	Q INSTALLED	98.08	77.7	F BETWEEN FLT GND CREW	96.78	76.7
			P REMOVED	12.30	9.7	H POST/1HRUFLT	17.94	14.1
			S REMOVE AND REINSTALL	7.33	5.8	D INFLIGHT NO ABORT	10.19	8.0
			X TEST-INSPECT-SERVICE	4.50	3.6	E AFTER FLIGHT	1.50	1.2
			G RPR/RPLT MINOR PARTS	4.00	3.2			
750 MISSING	122.23	1.4	Q INSTALLED	59.59	48.8	F BETWEEN FLT GND CREW	107.40	87.9
			G RPR/RPLT MINOR PARTS	54.22	44.4	Q SPECIAL INSPECTION	7.00	5.7
			F REPAIR	5.75	4.7	H POST/1HRUFLT	5.83	4.8
			R REMOVE AND REPLACE	2.00	1.6	K HOURLY POSTFLIGHT	2.00	1.6
			Y TROUBLESHOOT	0.67	0.5			
127 ADJMT/ALGNMT IMPROPR	113.54	1.3	G RPR/RPLT MINOR PARTS	50.34	44.3	F BETWEEN FLT GND CREW	86.94	76.6
			L ADJUST	39.11	34.4	H POST/1HRUFLT	14.80	13.0
			A BNCH CK AND REPAIRED	12.30	10.8	U INFLIGHT ABORT	11.80	10.4
			F REPAIR	11.80	10.4			
117 DETERIORATED	101.43	1.1	G RPR/RPLT MINOR PARTS	69.46	68.5	F BETWEEN FLT GND CREW	67.46	66.5
			F REPAIR	19.67	19.4	H POST/1HRUFLT	19.67	19.4
			Q INSTALLED	12.00	11.8	E AFTER FLIGHT	12.00	11.8
			R REMOVE AND REPLACE	0.30	0.3	M PERIODIC/PHASED INSP	2.00	2.0
						Q SPECIAL INSPECTION	0.30	0.3
605 CRAZED	98.02	1.1	Q INSTALLED	47.01	48.0	H POST/1HRUFLT	67.51	68.9
			P REMOVED	30.51	31.1	F BETWEEN FLT GND CREW	30.50	31.1
			R REMOVE AND REPLACE	20.50	20.9			
106 MISSING BOLTS,NUTS..	96.83	1.1	G RPR/RPLT MINOR PARTS	77.58	80.1	F BETWEEN FLT GND CREW	59.89	61.9

Figure A-1. F-4 Design/Cost MAMS (Continued)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

F-4 TRANSPARENCY WUCS ONAC AND SHOP 1/76-6/77 - MARSHALL STA 11-C3 MAR. 14, 1978 PAGE 24

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	544,662	470,536	$669,099	84,979.93	156.02

111AQ W/S PANEL FLAT CENTR (CONT.) $70,500 LSC/YEAR | PCT OF LSC 10.54 TOTAL | LSC RNK 5 | 8875.43 MAN HRS | PCT OF MHR 10.44 TOTAL | MHR RNK 5 | 16.2953 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF MMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF MMC
			Q INSTALLED	8.50	8.6	M PERIODIC/PHASED INSP	20.22	20.9
			A BNCH CK AND REPAIRED	5.67	5.9	J PREFLIGHT	7.00	7.2
			R REMOVE AND REPLACE	4.25	4.4	H POST/THRUFLT	6.78	7.0
			X TEST-INSPECT-SERVICE	0.83	0.9	D INFLIGHT NO ABORT	2.00	2.1
						K HOURLY POSTFLIGHT	0.83	0.9
						S DEPOT LEVEL MAINTNCE	0.10	0.1
070 BROKEN	62.01	0.7	P REMOVED	31.51	50.8	F BETWEEN FLT GND CREW	48.17	74.3
			R REMOVE AND REPLACE	16.50	26.6	C INFLIGHT ABORT	15.84	25.5
			G RPR/RPLT MINOR PARTS	11.00	17.7			
			Q INSTALLED	3.00	4.8			
230 DIRTY CONTAM SATURAT	46.19	0.5	P REMOVED	20.30	43.9	J PREFLIGHT	20.30	43.9
			V CLEAN	18.86	40.9	F BETWEEN FLT GND CREW	18.75	40.6
			G RPR/RPLT MINOR PARTS	7.00	15.2	D INFLIGHT NO ABORT	4.50	9.7
						R QC CHECK	1.00	2.2
						L TRAINING OR MAINTNCE	0.83	1.8
						H POST/THRUFLT	0.50	1.1
						M PERIODIC/PHASED INSP	0.30	0.6
425 NICKED	39.44	0.4	P REMOVED	17.60	44.6	F BETWEEN FLT GND CREW	39.44	100.0
			R REMOVE AND REPLACE	14.00	35.5			
			Q INSTALLED	7.83	19.9			
730 LOOSE	37.36	0.4	P REMOVED	22.25	59.6	F BETWEEN FLT GND CREW	29.09	77.9
			G RPR/RPLT MINOR PARTS	13.60	36.4	H POST/THRUFLT	8.27	22.1
			R REMOVE AND REPLACE	1.50	4.0			
303 BIRD STRIKE DAMAGE	25.90	0.3	P REMOVED	25.90	100.0	F BETWEEN FLT GND CREW	14.90	57.5
						C INFLIGHT ABORT	11.00	42.5
246 IMPROP/FAULTY MAINT	23.00	0.3	R REMOVE AND REPLACE	20.00	87.0	F BETWEEN FLT GND CREW	20.00	87.0
			G RPR/RPLT MINOR PARTS	3.00	13.0	J PREFLIGHT	3.00	13.0
689 POTTING MATL MELTING	22.25	0.3	G RPR/RPLT MINOR PARTS	11.25	50.6	F BETWEEN FLT GND CREW	22.25	100.0
			R REMOVE AND REPLACE	11.00	49.4			
170 CORRODED-MILD/MODRTE	21.75	0.2	Z CORROSION REPAIR	19.25	88.5	S DEPOT LEVEL MAINTNCE	13.00	59.8
			G RPR/RPLT MINOR PARTS	2.50	11.5	M PERIODIC/PHASED INSP	7.75	35.6
						4 CORROSION CONTR INSP	1.00	4.6
780 BENT,BUCKLED,COLLAPS	13.92	0.2	P REMOVED	10.00	71.8	F BETWEEN FLT GND CREW	12.67	91.0
			R REMOVE AND REPLACE	2.67	19.2	C INFLIGHT ABORT	1.25	9.0
			G RPR/RPLT MINOR PARTS	1.25	9.0			
130 CHANGE OF VALUE	11.84	0.1	F REPAIR	11.84	100.0	F BETWEEN FLT GND CREW	11.84	100.0
135 BINDING,STUCK,JAMMED	10.84	0.1	P REMOVED	7.50	69.2	D INFLIGHT NO ABORT	7.50	69.2

Figure A-1. F-4 Design/Cost MAMS (Continued)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

F-4 TRANSPARENCY WUCS ONAC AND SHOP 1/76-6/77 - MARSHALL STA 11-C3 MAR. 14, 1978 PAGE 25

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	544,662	470,536	$669,099	84,979.93	156.02

111AQ W/S PANEL FLAT CENTR (CONT.) $70,500 LSC/YEAR PCT OF LSC 10.54 TOTAL LSC RNK 5 6875.43 MAN HRS PCT OF MHR 10.44 TOTAL MHR RNK 5 16.2953 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF WMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF WMC
			G RPR/RPLT MINOR PARTS	3.33	30.7	H POST/1HRUFLT	3.33	30.7
782 TIRE TREAD DEFECTIVE	8.00	0.1	R REMOVE AND REPLACE	8.00	100.0	F BETWEEN FLT GND CREW	8.00	100.0
301 FOREIGN OBJ DAMAGE	6.00	0.1	P REMOVED	6.00	100.0	F BETWEEN FLT GND CREW	6.00	100.0
481 KEYWAY/SPLINE DAMAGE	5.00	0.1	G RPR/RPLT MINOR PARTS	5.00	100.0	D INFLIGHT NO ABORT	5.00	100.0
518 IMPROPER ROUTING	2.50	0.0	R REMOVE AND REPLACE	2.50	100.0	F BETWEEN FLT GND CREW	2.50	100.0
553 DOES NOT MEET SPEC	1.80	0.0	Y TROUBLESHOOT	1.80	100.0	Y RECEIPT FROM STOCK	1.80	100.0
947 TORN	1.00	0.0	G RPR/RPLT MINOR PARTS	1.00	100.0	M PERIODIC/PHASED INSP	1.00	100.0
540 PUNCTURED	0.70	0.0	G RPR/RPLT MINOR PARTS	0.70	100.0	F BETWEEN FLT GND CREW	0.70	100.0

Figure A-1. F-4 Design/Cost MAMS (Concluded)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

A-07 TRANSPARENCY W/CS ONAC AND SHOP 1/76-6/77 - MARSHALL STA 11-03 MAR. 16, 1979 PAGE 1

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	153,885	92,035	$188,214	20,038.42	130.21

11AC8 W/S GLASS ASSY L+RH $63,351 LSC/YEAR | PCT OF LSC 33.66 TOTAL | LSC RNK 1 | 6445.99 MAN HRS | PCT OF MHR 32.17 TOTAL | MHR RNK 1 | 41.8883 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF MUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF MMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF MMC
935 SCORED OR SCRATCHED	2093.26	32.5	R REMOVE AND REPLACE	1044.70	49.9	F BETWEEN FLT GND CREW	1393.09	66.6
			P REMOVED	374.14	17.9	M PERIODIC/PHASED INSP	286.74	13.7
			G RPR/RPLT MINOR PARTS	364.56	17.4	H POST/THRUFLT	136.33	6.5
			A BNCH CK AND REPAIRED	192.61	9.2	S DEPOT LEVEL MAINTNCE	125.20	6.0
			V CLEAN	50.06	2.4	D INFLIGHT NO ABORT	85.02	4.1
			Q INSTALLED	47.51	2.3	W IN-SHOP REPAIR	33.51	1.6
			X TEST-INSPECT-SERVICE	13.69	0.7	Q SPECIAL INSPECTION	16.17	0.8
			F REPAIR	6.00	0.3	U NON-DESTRUCTIVE INSP	7.00	0.3
						R QC CHECK	6.00	0.3
						C INFLIGHT ABORT	4.20	0.2
799 NO DEFECT	1399.16	21.7	Q INSTALLED	1197.46	85.6	F BETWEEN FLT GND CREW	1253.93	89.6
			X TEST-INSPECT-SERVICE	59.50	4.3	D INFLIGHT NO ABORT	62.14	4.4
			P REMOVED	56.00	4.0	H POST/THRUFLT	41.72	3.0
			T REMOVE FOR CANIBLZTN	40.44	2.9	M PERIODIC/PHASED INSP	30.57	2.2
			U RPLCD AFTER CANBLZTN	30.70	2.2	C INFLIGHT ABORT	8.80	0.6
			H EQUIP CK NO RPR RQRD	6.97	0.6	E AFTER FLIGHT	1.00	0.1
			R REMOVE AND REPLACE	6.00	0.4	S DEPOT LEVEL MAINTNCE	1.00	0.1
			V CLEAN	0.08	0.0			
800 NO DEF-RMVD-OTH MAINT	912.05	14.1	P REMOVED	478.64	52.5	F BETWEEN FLT GND CREW	739.09	81.0
			Q INSTALLED	357.15	39.2	D INFLIGHT NO ABORT	50.24	5.5
			S REMOVE AND REINSTALL	47.34	5.2	H POST/THRUFLT	50.14	5.5
			G RPR/RPLT MINOR PARTS	19.42	2.1	M PERIODIC/PHASED INSP	50.08	5.5
			R REMOVE AND REPLACE	9.50	1.0	E AFTER FLIGHT	12.20	1.3
						C INFLIGHT ABORT	8.30	0.9
						P FUNCTIONAL CK FLT	1.00	0.1
						Q SPECIAL INSPECTION	1.00	0.1
127 ADJMT/ALGNMT IMPROPR	463.32	7.2	L ADJUST	332.53	71.8	F BETWEEN FLT GND CREW	431.21	93.1
			G RPR/RPLT MINOR PARTS	105.45	22.8	M PERIODIC/PHASED INSP	32.10	6.9
			A BNCH CK AND REPAIRED	25.34	5.5			
020 WORN CHAFED OR FRAYD	224.23	3.5	G RPR/RPLT MINOR PARTS	168.85	75.3	M PERIODIC/PHASED INSP	120.70	53.8
			A BNCH CK AND REPAIRED	19.40	8.7	F BETWEEN FLT GND CREW	84.42	37.6
			Z CORROSION REPAIR	15.50	6.9	H POST/THRUFLT	13.53	6.0
			R REMOVE AND REPLACE	15.03	6.7	J PREFLIGHT	3.30	1.5
			X TEST-INSPECT-SERVICE	4.57	2.0	D INFLIGHT NO ABORT	2.00	0.9
			P REMOVED	0.80	0.4	R QC CHECK	0.20	0.1
			9 BNCH CK-CONDENNED	0.08	0.0	W IN-SHOP REPAIR	0.08	0.0
117 DETERIORATED	211.58	3.3	G RPR/RPLT MINOR PARTS	124.72	58.9	M PERIODIC/PHASED INSP	83.77	39.6
			Z CORROSION REPAIR	39.55	18.7	F BETWEEN FLT GND CREW	53.41	25.2
			R REMOVE AND REPLACE	31.30	14.8	R QC CHECK	36.00	17.0
			P REMOVED	16.00	7.6	J PREFLIGHT	31.30	14.8
						H POST/THRUFLT	7.10	3.4

Figure A-2. A-7D Design/Cost MAMS

DESIGN/COST MAINTENANCE ANALYSIS MODEL

A-07 TRANSPARENCY WUCS ONAC AND SHOP 1/76-6/77 - MARSHALL STA 11-C3 MAR. 16, 1978 PAGE 2

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	153,885	92,035	$188,214	20,038.42	130.21

11ACB W/S GLASS ASSY L+RH (CONT.) $63,351 LSC/YEAR | PCT OF LSC 33.66 TOTAL | LSC RNK 1 | 6445.99 MAN HRS | PCT OF MHR 32.17 TOTAL | MHR RNK 1 | 41.8803 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF MMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF MMC
105 LOOSE/DMGD BOLTS,NUT	210.61	3.3	G RPR/RPLT MINOR PARTS	207.26	98.4	F BETWEEN FLT GND CREW	182.97	86.9
			R REMOVE AND REPLACE	2.25	1.1	M PERIODIC/PHASED INSP	25.74	12.2
			A BNCH CK AND REPAIRED	0.70	0.3	J PREFLIGHT	1.70	0.8
			L ADJUST	0.40	0.2	Q SPECIAL INSPECTION	0.20	0.1
190 CRACKED	129.19	2.0	R REMOVE AND REPLACE	79.68	61.7	F BETWEEN FLT GND CREW	61.01	47.2
			P REMOVED	33.00	25.5	M PERIODIC/PHASED INSP	58.18	45.0
			L ADJUST	9.00	7.0	H POST/THRUFLT	10.00	7.7
			Q INSTALLED	6.00	4.6			
			A BNCH CK AND REPAIRED	1.50	1.2			
520 PITTED	129.18	2.0	R REMOVE AND REPLACE	104.68	81.0	F BETWEEN FLT GND CREW	52.00	40.3
			P REMOVED	15.00	11.6	H POST/THRUFLT	43.18	33.4
			G RPR/RPLT MINOR PARTS	9.50	7.4	C INFLIGHT ABORT	22.00	17.0
						M PERIODIC/PHASED INSP	12.00	9.3
605 CRAZED	124.44	1.9	R REMOVE AND REPLACE	69.17	55.6	H POST/THRUFLT	43.30	34.8
			P REMOVED	26.30	21.1	F BETWEEN FLT GND CREW	43.14	34.7
			A BNCH CK AND REPAIRED	18.30	14.7	M PERIODIC/PHASED INSP	34.00	27.3
			Q INSTALLED	5.17	4.2	D INFLIGHT NO ABORT	4.00	3.2
			G RPR/RPLT MINOR PARTS	3.50	2.8			
			X TEST-INSPECT-SERVICE	2.00	1.6			
910 CHIPPED	101.19	1.6	P REMOVED	53.07	52.4	F BETWEEN FLT GND CREW	87.03	86.0
			G RPR/RPLT MINOR PARTS	32.92	32.5	M PERIODIC/PHASED INSP	7.50	7.4
			A BNCH CK AND REPAIRED	8.20	8.1	D INFLIGHT NO ABORT	6.00	5.9
			R REMOVE AND REPLACE	7.00	6.9	R QC CHECK	0.67	0.7
846 DELAMINATED	97.71	1.5	R REMOVE AND REPLACE	49.50	50.7	F BETWEEN FLT GND CREW	39.30	40.2
			G RPR/RPLT MINOR PARTS	38.79	39.7	H POST/THRUFLT	24.42	25.0
			P REMOVED	9.42	9.6	M PERIODIC/PHASED INSP	17.99	18.4
						R QC CHECK	16.00	16.4
780 BENT,BUCKLED,COLLASP	80.88	1.3	G RPR/RPLT MINOR PARTS	51.07	63.1	M PERIODIC/PHASED INSP	50.07	61.9
			Q INSTALLED	23.01	34.6	D INFLIGHT NO ABORT	16.00	19.8
			V CLEAN	1.50	1.9	F BETWEEN FLT GND CREW	14.80	18.3
			X TEST-INSPECT-SERVICE	0.30	0.4			
381 LEAKING INT OR EXT	61.20	0.9	G RPR/RPLT MINOR PARTS	33.60	54.9	F BETWEEN FLT GND CREW	45.20	73.9
			R REMOVE AND REPLACE	16.00	26.1	D INFLIGHT NO ABORT	16.00	26.1
			P REMOVED	11.60	19.0			
425 NICKED	57.50	0.9	G RPR/RPLT MINOR PARTS	35.50	61.7	F BETWEEN FLT GND CREW	29.70	51.7
			R REMOVE AND REPLACE	22.00	38.3	H POST/THRUFLT	16.00	27.8
						M PERIODIC/PHASED INSP	11.80	20.5
106 MISSING BOLTS,NUTS..	54.92	0.9	G RPR/RPLT MINOR PARTS	54.42	99.1	F BETWEEN FLT GND CREW	44.17	80.4
			Q INSTALLED	0.50	0.9	M PERIODIC/PHASED INSP	10.25	18.7

Figure A-2. A-7D Design/Cost MAMS (Continued)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

A-07 TRANSPARENCY WUCS ONAC AND SHOP 1/76-6/77 - MARSHALL STA 11-C3 MAR. 16, 1978 PAGE 3

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	153,885	92,035	$188,214	20,038.42	130.21

11AC8 W/S GLASS ASSY L+RH (CONT.) $63,351 LSC/YEAR | PCT OF LSC 33.66 TOTAL | LSC RNK 1 | 6445.99 MAN HRS | PCT OF MHR 32.17 TOTAL | MHR RNK 1 | 41.8883 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF MMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF MMC
						J PREFLIGHT	0.50	0.9
865 PROT COAT/SEALNT DEF	31.70	0.5	G RPR/RPLT MINOR PARTS	28.20	89.0	M PERIODIC/PHASED INSP	21.30	67.2
			Z CORROSION REPAIR	3.50	11.0	F BETWEEN FLT GND CREW	8.10	25.6
						R QC CHECK	2.30	7.3
230 DIRTY CONTAM SATURAT	29.09	0.5	V CLEAN	20.42	70.2	M PERIODIC/PHASED INSP	20.32	69.9
			R REMOVE AND REPLACE	4.50	15.5	F BETWEEN FLT GND CREW	5.27	18.1
			G RPR/RPLT MINOR PARTS	3.67	12.6	A BEFORE FLT ABORT	2.50	8.6
			X TEST-INSPECT-SERVICE	0.50	1.7	D INFLIGHT NO ABORT	1.00	3.4
070 BROKEN	7.27	0.1	G RPR/RPLT MINOR PARTS	7.27	100.0	F BETWEEN FLT GND CREW	6.10	83.9
						M PERIODIC/PHASED INSP	1.17	16.1
750 MISSING	4.33	0.1	R REMOVE AND REPLACE	3.83	88.5	M PERIODIC/PHASED INSP	3.83	88.5
			Q INSTALLED	0.50	11.5	B BEFORE FLT NO ABORT	0.50	11.5
947 TORN	4.00	0.1	G RPR/RPLT MINOR PARTS	4.00	100.0	F BETWEEN FLT GND CREW	4.00	100.0
660 STRIPPED	3.90	0.1	G RPR/RPLT MINOR PARTS	3.00	76.9	F BETWEEN FLT GND CREW	2.90	74.4
			P REMOVED	0.90	23.1	M PERIODIC/PHASED INSP	1.00	25.6
719 BRK/FRYED BND/GND WR	3.50	0.1	G RPR/RPLT MINOR PARTS	3.50	100.0	M PERIODIC/PHASED INSP	3.50	100.0
932 DOES NOT ENGAGE/LOCK	3.50	0.1	P REMOVED	3.50	100.0	F BETWEEN FLT GND CREW	3.50	100.0
135 BINDING,STUCK,JAMMED	2.12	0.0	R REMOVE AND REPLACE	1.42	67.0	M PERIODIC/PHASED INSP	1.42	67.0
			G RPR/RPLT MINOR PARTS	0.70	33.0	F BETWEEN FLT GND CREW	0.70	33.0
246 IMPROP/FAULTY MAINT	2.00	0.0	R REMOVE AND REPLACE	2.00	100.0	F BETWEEN FLT GND CREW	2.00	100.0
635 SENSITIVITY INCORR	1.83	0.0	A BNCH CK AND REPAIRED	1.83	100.0	F BETWEEN FLT GND CREW	1.83	100.0
730 LOOSE	1.67	0.0	R REMOVE AND REPLACE	1.67	100.0	R QC CHECK	1.67	100.0
622 WET/CONDENSATION	0.60	0.0	Q INSTALLED	0.60	100.0	H POST/THRUFLT	0.60	100.0
410 LACK OF/IMPROPR LUBE	0.08	0.0	Q INSTALLED	0.08	100.0	M PERIODIC/PHASED INSP	0.08	100.0

Figure A-2. A-7D Design/Cost MAMS (Continued)

FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
153,685	92,035	$188,214	20,038.42	130.21

ASSY $50,628 LSC/YEAR | PCT OF LSC 26.90 TOTAL | LSC RNK 2 | 4761.52 MAN HRS | PCT OF MHR 23.76 TOTAL | MHR RNK 2 | 30.9420 MANHR /1000 FLT HR

ON	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF MMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF MMC
	1125.28	23.6	Q INSTALLED	828.79	73.7	F BETWEEN FLT GND CREW	864.20	76.8
			X TEST-INSPECT-SERVICE	158.63	14.1	M PERIODIC/PHASED INSP	118.91	10.6
			L ADJUST	96.77	8.6	D INFLIGHT NO ABORT	52.50	4.7
			P REMOVED	20.67	1.8	H POST/THRUFLT	39.26	3.5
			R REMOVE AND REPLACE	12.00	1.1	C INFLIGHT ABORT	31.20	2.8
			H EQUIP CK NO RPR RQRD	8.42	0.7	R QC CHECK	11.50	1.0
						Q SPECIAL INSPECTION	6.30	0.6
						U NON-DESTRUCTIVE INSP	0.75	0.1
						A BEFORE FLT ABORT	0.67	0.1
SCRATCHED	934.66	19.6	A BNCH CK AND REPAIRED	515.68	55.2	F BETWEEN FLT GND CREW	788.30	84.3
			G RPR/RPLT MINOR PARTS	151.73	16.2	M PERIODIC/PHASED INSP	79.80	8.5
			P REMOVED	147.54	15.8	H POST/THRUFLT	33.01	3.5
			F REPAIR	65.80	7.0	A BEFORE FLT ABORT	28.30	3.0
			Q INSTALLED	26.01	2.8	D INFLIGHT NO ABORT	4.00	0.4
			V CLEAN	19.25	2.1	S DEPOT LEVEL MAINTNCE	1.25	0.1
			R REMOVE AND REPLACE	8.00	0.9			
			X TEST-INSPECT-SERVICE	0.67	0.1			
VD-OTH MAINT	823.36	17.3	F REMOVED	463.02	56.1	F BETWEEN FLT GND CREW	690.16	83.6
			Q INSTALLED	283.15	34.3	M PERIODIC/PHASED INSP	78.58	9.5
			G RPR/RPLT MINOR PARTS	40.80	4.9	D INFLIGHT NO ABORT	26.67	3.2
			S REMOVE AND REINSTALL	24.72	3.0	H POST/THRUFLT	21.25	2.6
			X TEST-INSPECT-SERVICE	8.67	1.1	C INFLIGHT ABORT	4.00	0.5
			L ADJUST	5.00	0.6	Q SPECIAL INSPECTION	3.30	0.4
						J PREFLIGHT	1.40	0.2
MNT IMPROPR	701.05	14.7	L ADJUST	578.49	82.5	F BETWEEN FLT GND CREW	421.46	60.1
			A BNCH CK AND REPAIRED	45.18	6.4	H POST/THRUFLT	95.10	13.6
			Y TROUBLESHOOT	37.67	5.4	M PERIODIC/PHASED INSP	49.52	7.1
			G RPR/RPLT MINOR PARTS	36.22	5.2	Q SPECIAL INSPECTION	36.00	5.1
			X TEST-INSPECT-SERVICE	3.50	0.5	S DEPOT LEVEL MAINTNCE	36.00	5.1
						A BEFORE FLT ABORT	18.80	2.7
						D INFLIGHT NO ABORT	15.00	2.1
						B BEFORE FLT NO ABORT	10.00	1.4
						W IN-SHOP REPAIR	8.75	1.2
						J PREFLIGHT	7.50	1.1
						P FUNCTIONAL CK FLT	1.92	0.3
						C INFLIGHT ABORT	1.00	0.1
TO LOSTINF	264.67	5.6	G RPR/RPLT MINOR PARTS	213.77	80.8	C INFLIGHT ABORT	263.92	99.7
			Y TROUBLESHOOT	46.60	17.6	H POST/THRUFLT	0.75	0.3
			X TEST-INSPECT-SERVICE	3.30	1.2			
			Q INSTALLED	1.00	0.4			
	182.27	3.8	A BNCH CK AND REPAIRED	85.90	47.1	F BETWEEN FLT GND CREW	120.41	66.1
			G RPR/RPLT MINOR PARTS	77.62	42.6	M PERIODIC/PHASED INSP	27.76	15.2

Figure A-2. A-7D Design/Cost MAMS (Continued)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

A-07 TRANSPARENCY WUCS ONAC AND SHOP 1/76-6/77 - MARSHALL STA 11-C3 MAR. 16, 1978 PAGE 5

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	153,885	92,035	$188,214	20,038.42	130.21

12AA6 CANOPY ASSY (CONT.)	$59,628 LSC/YEAR	PCT OF LSC 26.90 TOTAL	LSC RNK 2	4761.52 MAN-HRS	PCT OF MHR 23.76 TOTAL	MHR RNK 2	30.9420 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF HMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF HMC
			P REMOVED	12.00	6.6	H POST/THRUFLT	26.30	14.4
			Q INSTALLED	6.75	3.7	D INFLIGHT NO ABORT	5.80	3.2
						B BEFORE FLT NO ABORT	2.00	1.1
190 CRACKED	170.92	3.8	G RPR/RPLT MINOR PARTS	95.24	55.7	F BETWEEN FLT GND CREW	128.91	75.4
			A BNCH CK AND REPAIRED	60.18	35.2	M PERIODIC/PHASED INSP	29.50	17.3
			Y TROUBLESHOOT	8.00	4.7	H POST/THRUFLT	12.50	7.3
			P REMOVED	7.50	4.4			
105 LOOSE/DMGD BOLTS,NUT	75.94	1.6	G RPR/RPLT MINOR PARTS	58.04	76.4	M PERIODIC/PHASED INSP	31.57	41.6
			F REPAIR	17.40	22.9	F BETWEEN FLT GND CREW	26.47	34.9
			L ADJUST	0.50	0.7	G GROUND ALERT-NOT DGR	17.40	22.9
						D INFLIGHT NO ABORT	0.50	0.7
780 BENT,BUCKLED,COLLASP	70.20	1.5	A BNCH CK AND REPAIRED	52.50	74.8	F BETWEEN FLT GND CREW	67.90	96.7
			P REMOVED	7.40	10.5	D INFLIGHT NO ABORT	2.00	2.8
			G RPR/RPLT MINOR PARTS	7.30	10.4	M PERIODIC/PHASED INSP	0.30	0.4
			L ADJUST	2.00	2.8			
			2 BNCH CK-NRTS-LCK EQP	1.00	1.4			
810 CHIPPED	54.80	1.2	A BNCH CK AND REPAIRED	31.40	57.2	F BETWEEN FLT GND CREW	37.20	67.8
			P REMOVED	23.00	41.9	H POST/THRUFLT	11.70	21.3
			G RPR/RPLT MINOR PARTS	0.50	0.9	M PERIODIC/PHASED INSP	6.00	10.9
070 BROKEN	54.01	1.1	R REMOVE AND REPLACE	24.00	44.4	C INFLIGHT ABORT	29.84	55.2
			Q INSTALLED	20.84	38.6	F BETWEEN FLT GND CREW	17.00	31.5
			G RPR/RPLT MINOR PARTS	5.92	11.0	L TRAINING OR MAINTNCE	3.92	7.3
			K TEST-INSPECT-SERVICE	3.25	6.0	A BEFORE FLT ABORT	3.25	6.0
946 DELAMINATED	52.59	1.1	G RPR/RPLT MINOR PARTS	36.59	69.6	F BETWEEN FLT GND CREW	52.59	100.0
			P REMOVED	8.50	16.2			
			Q INSTALLED	7.50	14.3			
020 WORN CHAFED OR FRAYD	46.09	1.0	A BNCH CK AND REPAIRED	33.09	71.8	F BETWEEN FLT GND CREW	33.09	71.8
			G RPR/RPLT MINOR PARTS	12.00	26.0	M PERIODIC/PHASED INSP	6.00	13.0
			R REMOVE AND REPLACE	1.00	2.2	J PREFLIGHT	4.00	8.7
						H POST/THRUFLT	2.50	5.4
						D INFLIGHT NO ABORT	0.50	1.1
230 DIRTY CONTAM SATURAT	30.53	0.6	V CLEAN	18.03	59.1	M PERIODIC/PHASED INSP	13.30	43.6
			R REMOVE AND REPLACE	8.00	26.2	L TRAINING OR MAINTNCE	8.23	27.0
			G RPR/RPLT MINOR PARTS	4.00	13.1	D INFLIGHT NO ABORT	8.00	26.2
			Y TROUBLESHOOT	0.50	1.6	B BEFORE FLT NO ABORT	0.50	1.6
						F BETWEEN FLT GND CREW	0.50	1.6
932 DOES NOT ENGAGE/LOCK	24.09	0.5	Y TROUBLESHOOT	11.00	45.7	D INFLIGHT NO ABORT	9.00	37.4
			L ADJUST	9.00	37.4	H POST/THRUFLT	7.00	29.1
			G RPR/RPLT MINOR PARTS	4.08	16.9	F BETWEEN FLT GND CREW	6.58	27.3

Figure A-2. A-7D Design/Cost MAMS (Continued)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

A-07 TRANSPARENCY WUCS ONAC AND SHOP 1/76-6/77 - MARSHALL STA 11-C3 MAR. 16, 1978 PAGE 8

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	153,885	92,035	$188,214	20,038.42	130.21

12AA0 CANOPY ASSY (CONT.)	$50,628 LSC/YEAR	PCT OF LSC 26.90	TOTAL	LSC RNK 2	4761.52 MAN HRS	PCT OF MHR 23.76	TOTAL	MHR RNK 2	30.9420 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF HMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF HMC
						B BEFORE FLT NO ABORT	1.00	4.2
						A BEFORE FLT ABORT	0.50	2.1
931 ACDT OPERATION/RELSE	23.00	0.5	P REMOVED	23.00	100.0	F BETWEEN FLT GND CREW	23.00	100.0
135 BINDING,STUCK,JAMMED	16.70	0.4	Y TROUBLESHOOT	9.60	57.5	D INFLIGHT NO ABORT	8.00	47.9
			L ADJUST	3.50	21.0	M PERIODIC/PHASED INSP	4.10	24.6
			G RPR/RPLT MINOR PARTS	2.10	12.6	F BETWEEN FLT GND CREW	3.00	18.0
			X TEST-INSPECT-SERVICE	1.50	9.0	B BEFORE FLT NO ABORT	1.30	7.8
						A BEFORE FLT ABORT	0.30	1.8
947 TORN	16.60	0.3	A BNCH CK AND REPAIRED	16.00	96.4	F BETWEEN FLT GND CREW	16.60	100.0
			G RPR/RPLT MINOR PARTS	0.60	3.6			
106 MISSING BOLTS,NUTS..	13.30	0.3	G RPR/RPLT MINOR PARTS	13.30	100.0	F BETWEEN FLT GND CREW	9.00	67.7
						M PERIODIC/PHASED INSP	4.30	32.3
242 FAILED TO OPERATE	12.00	0.3	Y TROUBLESHOOT	12.00	100.0	D INFLIGHT NO ABORT	12.00	100.0
117 DETERIORATED	10.80	0.2	G RPR/RPLT MINOR PARTS	7.05	65.3	F BETWEEN FLT GND CREW	5.45	50.5
			Y TROUBLESHOOT	3.75	34.7	H POST/THRUFLT	3.00	27.8
						M PERIODIC/PHASED INSP	2.35	21.8
602 FAILED DUE TO OTHMAL	8.00	0.2	R REMOVE AND REPLACE	8.00	100.0	F BETWEEN FLT GND CREW	8.00	100.0
170 CORRODED-MILD/MODRTE	7.00	0.1	A BNCH CK AND REPAIRED	7.00	100.0	D INFLIGHT NO ABORT	7.00	100.0
425 NICKED	6.00	0.1	G RPR/RPLT MINOR PARTS	6.00	100.0	M PERIODIC/PHASED INSP	6.00	100.0
804 NO DEF-SCH MAINT/MOD	5.80	0.1	P REMOVED	5.80	100.0	M PERIODIC/PHASED INSP	5.80	100.0
660 STRIPPED	5.78	0.1	G RPR/RPLT MINOR PARTS	5.20	90.0	F BETWEEN FLT GND CREW	5.78	100.0
			P REMOVED	0.58	10.0			
955 DATA LINK ERROR	4.70	0.1	P REMOVED	4.70	100.0	F BETWEEN FLT GND CREW	4.70	100.0
374 INTERNAL FAILURE	4.33	0.1	Y TROUBLESHOOT	4.33	100.0	A BEFORE FLT ABORT	3.00	69.3
						B BEFORE FLT NO ABORT	1.33	30.7
730 LOOSE	3.50	0.1	G RPR/RPLT MINOR PARTS	2.50	71.4	F BETWEEN FLT GND CREW	2.50	71.4
			R REMOVE AND REPLACE	1.00	28.6	D INFLIGHT NO ABORT	1.00	28.6
525 PRESSURE INCORRECT	2.83	0.1	X TEST-INSPECT-SERVICE	2.83	100.0	E AFTER FLIGHT	1.00	35.3
						F BETWEEN FLT GND CREW	1.00	35.3
						A BEFORE FLT ABORT	0.83	29.3
540 PUNCTURED	2.25	0.0	G RPR/RPLT MINOR PARTS	2.25	100.0	F BETWEEN FLT GND CREW	2.25	100.0

Figure A-2. A-7D Design/Cost MAMS (Continued)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

A-07 TRANSPARENCY WUCS ONAC AND SHOP 1/76-6/77 - MARSHALL STA 11-C3 MAR. 16, 1978 PAGE 7

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	153,895	92,035	$188,214	20,038.42	130.21

12AA0 CANOPY ASSY (CONT.)	$50,628	LSC/ YEAR	PCT OF LSC 26.90	TOTAL	LSC RNK 2	4761.52	MAN HRS	PCT OF MHR 23.76	TOTAL	MHR RNK 2	30.9420 MANHR /1000 FLT HR

HOW MALFUNCTION CODE	NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE	NAME	MAN HOURS	PERCENT OF HMC	WHEN DISCOVERED CODE	NAME	MAN HOURS	PERCENT OF HMC
391	LEAKING INT OR EXT	1.50	0.0	R	REMOVE AND REPLACE	1.00	66.7	F	BETWEEN FLT GND CREW	1.00	66.7
				X	TEST-INSPECT-SERVICE	0.50	33.3	B	BEFORE FLT NO ABORT	0.50	33.3
948	NO DEF-OPERATOR ERR	1.50	0.0	X	TEST-INSPECT-SERVICE	1.50	100.0	F	BETWEEN FLT GND CREW	1.50	100.0
750	MISSING	1.20	0.0	G	RPR/RPLT MINOR PARTS	1.20	100.0	F	BETWEEN FLT GND CREW	1.00	83.3
								M	PERIODIC/PHASED INSP	0.20	16.7
080	DEFECTIVE LAMP/METER	1.00	0.0	G	RPR/RPLT MINOR PARTS	1.00	100.0	F	BETWEEN FLT GND CREW	1.00	100.0
865	PROT COAT/SEALNT DEF	0.90	0.0	G	RPR/RPLT MINOR PARTS	0.90	100.0	M	PERIODIC/PHASED INSP	0.90	100.0
469	BUSHING WORN/DAMAGED	0.25	0.0	G	RPR/RPLT MINOR PARTS	0.25	100.0	F	BETWEEN FLT GND CREW	0.25	100.0

Figure A-2. A-7D Design/Cost MAMS (Continued)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

A-07 TRANSPARENCY WUCS ONAC AND SHOP 1/76-6/77 - MARSHALL STA 11-C3 MAR. 16, 1978 PAGE 8

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	153,888	92,935	$188,214	20,038.42	130.21

12AAA CANOPY GLASS $36,093 LSC/YEAR | PCT OF LSC 19.18 TOTAL | LSC RNK 3 | 3332.51 MAN HRS | PCT OF MHR 16.63 TOTAL | MHR RNK 3 | 21.6558 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF WMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF WMC
935 SCORED OR SCRATCHED	1484.33	44.5	A BNCH CK AND REPAIRED	829.87	55.9	F BETWEEN FLT GND CREW	1006.50	67.8
			G RPR/RPLT MINOR PARTS	565.87	38.1	D INFLIGHT NO ABORT	232.54	15.7
			R REMOVE AND REPLACE	44.00	3.0	M PERIODIC/PHASED INSP	153.67	10.4
			P REMOVED	17.50	1.2	Q SPECIAL INSPECTION	58.34	4.8
			V CLEAN	16.30	1.1	J PREFLIGHT	11.00	0.7
			X TEST-INSPECT-SERVICE	10.78	0.7	H POST/THRUFLT	7.58	0.5
						S DEPOT LEVEL MAINTNCE	4.70	0.3
605 CRAZED	642.31	19.3	G RPR/RPLT MINOR PARTS	299.29	46.4	F BETWEEN FLT GND CREW	340.65	53.0
			A BNCH CK AND REPAIRED	260.66	40.6	M PERIODIC/PHASED INSP	163.86	25.5
			R REMOVE AND REPLACE	67.36	10.5	D INFLIGHT NO ABORT	107.70	16.8
			P REMOVED	8.00	1.2	J PREFLIGHT	15.60	2.4
			Q INSTALLED	8.00	1.2	S DEPOT LEVEL MAINTNCE	14.50	2.3
845 DELAMINATED	161.30	4.8	R REMOVE AND REPLACE	128.28	79.5	Q SPECIAL INSPECTION	128.28	79.5
			G RPR/RPLT MINOR PARTS	33.02	20.5	M PERIODIC/PHASED INSP	17.42	10.8
						F BETWEEN FLT GND CREW	15.60	9.7
190 CRACKED	139.49	4.2	G RPR/RPLT MINOR PARTS	93.68	67.2	F BETWEEN FLT GND CREW	139.49	100.0
			A BNCH CK AND REPAIRED	45.80	32.8			
910 CHIPPED	123.38	3.7	R REMOVE AND REPLACE	51.90	42.1	F BETWEEN FLT GND CREW	71.48	57.9
			A BNCH CK AND REPAIRED	51.06	41.4	M PERIODIC/PHASED INSP	51.90	42.1
			Q INSTALLED	12.00	9.7			
			G RPR/RPLT MINOR PARTS	8.42	6.8			
020 WORN CHAFED OR FRAYD	107.38	3.2	G RPR/RPLT MINOR PARTS	81.34	75.7	F BETWEEN FLT GND CREW	79.99	74.5
			A BNCH CK AND REPAIRED	24.84	23.1	M PERIODIC/PHASED INSP	26.97	25.1
			X TEST-INSPECT-SERVICE	1.20	1.1	H POST/THRUFLT	0.42	0.4
230 DIRTY CONTAM SATURAT	107.08	3.2	V CLEAN	50.18	46.8	F BETWEEN FLT GND CREW	34.80	32.5
			G RPR/RPLT MINOR PARTS	33.00	30.8	M PERIODIC/PHASED INSP	30.09	28.8
			A BNCH CK AND REPAIRED	23.92	22.3	D INFLIGHT NO ABORT	26.17	24.4
						L TRAINING OR MAINTNCE	12.92	12.1
						H POST/THRUFLT	1.50	1.4
						B BEFORE FLT NO ABORT	0.50	0.5
						Q SPECIAL INSPECTION	0.30	0.3
817 IMPND FAIL IND BYISP	104.77	3.1	A BNCH CK AND REPAIRED	68.85	65.7	F BETWEEN FLT GND CREW	104.77	100.0
			G RPR/RPLT MINOR PARTS	35.92	34.3			
799 NO DEFECT	101.24	3.0	Q INSTALLED	74.76	73.8	F BETWEEN FLT GND CREW	88.35	87.3
			P REMOVED	16.00	15.8	H POST/THRUFLT	10.50	10.4
			H EQUIP CK NO RPR RQRD	6.57	6.5	M PERIODIC/PHASED INSP	1.60	1.6
			X TEST-INSPECT-SERVICE	2.90	2.9	D INFLIGHT NO ABORT	0.58	0.6
			G RPR/RPLT MINOR PARTS	1.00	1.0	S DEPOT LEVEL MAINTNCE	0.20	0.2

Figure A-2. A-7D Design/Cost MAMS (Continued)

DESIGN/COST MAINTEN. .E ANALYSIS MODEL

A-07 TRANSPARENCY WUCS ONAC AND SHOP 1/76-6/77 - MARSHALL STA 11-C3 MAR. 18, 1978 PAGE 9

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	153,885	92,035	$188,214	20,038.42	130.21

12AAA CANOPY GLASS (CONT.) $36,093 LSC/YEAR | PCT OF LSC 19.18 TOTAL | LSC RNK 3 | 3332.51 MAN HRS | PCT OF MHR 16.63 TOTAL | MHR RNK 3 | 21.6558 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF HMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF HMC
780 BENT,BUCKLED,COLLAPS	98.43	3.0	A BNCH CK AND REPAIRED	98.43	100.0	F BETWEEN FLT GND CREW	98.43	100.0
127 ADJMT/ALIGNMT IMPROPR	50.84	1.5	G RPR/RPLT MINOR PARTS	22.84	44.9	F BETWEEN FLT GND CREW	47.84	94.1
			A BNCH CK AND REPAIRED	19.00	37.4	M PERIODIC/PHASED INSP	3.00	5.9
			L ADJUST	9.00	17.7			
117 DETERIORATED	48.91	1.5	G RPR/RPLT MINOR PARTS	23.50	48.9	F BETWEEN FLT GND CREW	25.00	51.1
			A BNCH CK AND REPAIRED	12.50	25.6	M PERIODIC/PHASED INSP	23.90	48.9
			P REMOVED	12.50	25.6			
570 BROKEN	48.01	1.4	A BNCH CK AND REPAIRED	31.34	65.3	D INFLIGHT NO ABORT	32.01	66.7
			G RPR/RPLT MINOR PARTS	16.67	34.7	F BETWEEN FLT GND CREW	16.00	33.3
425 NICKED	43.42	1.3	A BNCH CK AND REPAIRED	22.00	50.7	F BETWEEN FLT GND CREW	35.70	82.2
			G RPR/RPLT MINOR PARTS	21.42	49.3	M PERIODIC/PHASED INSP	5.80	13.4
						S DEPOT LEVEL MAINTNCE	1.92	4.4
800 NO DEF-RMVD-OTH MAINT	29.30	0.9	P REMOVED	29.30	100.0	F BETWEEN FLT GND CREW	29.30	100.0
105 LOOSE/DMGD BOLTS,NUT	17.12	0.5	G RPR/RPLT MINOR PARTS	17.12	100.0	F BETWEEN FLT GND CREW	11.27	65.8
						M PERIODIC/PHASED INSP	5.85	34.2
965 PROT COAT/SEALNT DEF	10.70	0.3	G RPR/RPLT MINOR PARTS	8.37	78.2	H POST/THRUFLT	4.67	43.6
			A BNCH CK AND REPAIRED	2.33	21.8	M PERIODIC/PHASED INSP	3.70	34.6
						F BETWEEN FLT GND CREW	2.33	21.8
947 TORN	5.00	0.2	A BNCH CK AND REPAIRED	5.00	100.0	F BETWEEN FLT GND CREW	5.00	100.0
932 DOES NOT ENGAGE/LOCK	4.00	0.1	G RPR/RPLT MINOR PARTS	4.00	100.0	F BETWEEN FLT GND CREW	4.00	100.0
108 MISSING BOLTS,NUTS..	2.33	0.1	G RPR/RPLT MINOR PARTS	2.33	100.0	M PERIODIC/PHASED INSP	2.33	100.0
730 LOOSE	1.50	0.0	G RPR/RPLT MINOR PARTS	1.50	100.0	M PERIODIC/PHASED INSP	1.50	100.0
943 DATA ERROR	0.60	0.0	G RPR/RPLT MINOR PARTS	0.60	100.0	F BETWEEN FLT GND CREW	0.60	100.0
719 BRK/FRYED BND/GND WR	0.50	0.0	G RPR/RPLT MINOR PARTS	0.50	100.0	M PERIODIC/PHASED INSP	0.50	100.0
170 CORRODED-MILD/MODRTE	0.25	0.0	Q INSTALLED	0.25	100.0	M PERIODIC/PHASED INSP	0.25	100.0
525 PRESSURE INCORRECT	0.25	0.0	X TEST-INSPECT-SERVICE	0.25	100.0	D INFLIGHT NO ABORT	0.25	100.0
188 BRK/MSG SAFETY WIRE	0.08	0.0	G RPR/RPLT MINOR PARTS	0.08	100.0	M PERIODIC/PHASED INSP	0.08	100.0

Figure A-2. A-7D Design/Cost MAMS (Continued)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

A-07 TRANSPARENCY WUCS ORAC AND SHOP 1/76-6/77 - MARSHALL STA 11-03 MAR. 16, 1978 PAGE 10

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	153,885	92,835	$188,214	20,036.42	130.21

11ACA W/S GLASS ASSY CTR $19,599 LSC/YEAR | PCT OF LSC 10.41 | LSC RNK TOTAL 4 | 2377.39 MAN HRS | PCT OF MHR 11.86 | MHR RNK TOTAL 4 | 15.4491 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF HMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF HMC
799 NO DEFECT	611.15	25.7	Q INSTALLED	583.18	95.4	F BETWEEN FLT GND CREW	231.63	37.9
			P REMOVED	24.00	3.9	M PERIODIC/PHASED INSP	142.19	23.3
			X TEST-INSPECT-SERVICE	3.80	0.6	H POST/THRUFLT	100.52	16.4
			H EQUIP CK NO APR BORD	0.17	0.0	C INFLIGHT ABORT	58.31	9.5
						W IN-SHOP REPAIR	38.01	6.2
						D INFLIGHT NO ABORT	24.00	3.9
						J PREFLIGHT	16.50	2.7
910 CHIPPED	605.05	25.5	R REMOVE AND REPLACE	272.59	45.1	F BETWEEN FLT GND CREW	245.30	40.5
			G RPR/RPLT MINOR PARTS	164.15	27.1	M PERIODIC/PHASED INSP	142.54	23.6
			P REMOVED	125.64	20.8	H POST/THRUFLT	92.58	15.3
			Q INSTALLED	40.01	6.6	R QC CHECK	45.51	7.5
			Y TROUBLESHOOT	2.67	0.4	J PREFLIGHT	40.01	6.6
						P FUNCTIONAL CK FLT	25.00	4.1
						D INFLIGHT NO ABORT	14.00	2.3
190 CRACKED	426.13	17.9	R REMOVE AND REPLACE	266.41	62.5	D INFLIGHT NO ABORT	167.70	39.4
			P REMOVED	115.21	27.0	F BETWEEN FLT GND CREW	111.31	26.1
			G RPR/RPLT MINOR PARTS	32.34	7.6	M PERIODIC/PHASED INSP	80.68	14.2
			Y TROUBLESHOOT	7.50	1.8	C INFLIGHT ABORT	45.90	10.8
			A BNCH CK AND REPAIRED	4.67	1.1	H POST/THRUFLT	40.54	9.5
846 DELAMINATED	163.37	6.9	R REMOVE AND REPLACE	73.01	44.7	M PERIODIC/PHASED INSP	96.35	59.0
			G RPR/RPLT MINOR PARTS	63.85	39.1	F BETWEEN FLT GND CREW	51.51	31.5
			Q INSTALLED	23.50	14.4	H POST/THRUFLT	15.50	9.5
			A BNCH CK AND REPAIRED	3.00	1.8			
381 LEAKING INT OR EXT	99.71	4.2	R REMOVE AND REPLACE	63.20	63.4	F BETWEEN FLT GND CREW	77.70	77.9
			G RPR/RPLT MINOR PARTS	31.50	31.6	D INFLIGHT NO ABORT	21.00	21.1
			Y TROUBLESHOOT	5.00	5.0	Q SPECIAL INSPECTION	1.00	1.0
935 SCORED OR SCRATCHED	95.51	4.0	R REMOVE AND REPLACE	38.34	40.1	F BETWEEN FLT GND CREW	68.34	71.6
			P REMOVED	29.50	30.9	M PERIODIC/PHASED INSP	13.34	14.0
			G RPR/RPLT MINOR PARTS	21.87	22.9	D INFLIGHT NO ABORT	10.34	10.8
			X TEST-INSPECT-SERVICE	4.80	5.0	Q SPECIAL INSPECTION	3.50	3.7
			V CLEAN	1.00	1.0			
865 PROT COAT/SEALNT DEF	54.67	2.3	G RPR/RPLT MINOR PARTS	44.00	80.5	F BETWEEN FLT GND CREW	31.40	57.4
			V CLEAN	5.17	9.5	M PERIODIC/PHASED INSP	14.60	26.7
			F REPAIR	3.50	6.4	W IN-SHOP REPAIR	5.17	9.5
			L ADJUST	2.00	3.7	H POST/THRUFLT	3.50	6.4
800 NO DEF-RMVD-OTH MAINT	52.26	2.2	S REMOVE AND REINSTALL	21.97	41.9	F BETWEEN FLT GND CREW	42.71	81.7
			Q INSTALLED	16.95	32.4	D INFLIGHT NO ABORT	6.00	11.5
			P REMOVED	10.09	19.3	H POST/THRUFLT	3.55	6.8
			R REMOVE AND REPLACE	3.30	6.3			

Figure A-2. A-7D Design/Cost MAMS (Continued)

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	153,885	92,035	$188,214	20,038.42	130.21

11ACA W/S GLASS ASSY CTR (CONT.) $19,599 LSC/YEAR | PCT OF LSC 10.41 TOTAL | LSC RNK 4 | 2377.39 MAN HRS | PCT OF MHR 11.86 TOTAL | MHR RNK 4 | 15.4491 MANHR /1000 FLT HR

HOW MALFUNCTION CODE	NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE	NAME	MAN HOURS	PERCENT OF WMC	WHEN DISCOVERED CODE	NAME	MAN HOURS	PERCENT OF WMC
117	DETERIORATED	30.52	1.6	G	RPR/RPLT MINOR PARTS	30.32	78.7	F	BETWEEN FLT GND CREW	21.70	56.3
				P	REMOVED	8.20	21.3	M	PE IC/PHASED INSP	16.82	43.7
105	LOOSE/DMGD BOLTS,NUT	36.42	1.5	G	RPR/RPLT MINOR PARTS	36.42	100.0	F	BE FLT GND CREW	19.95	54.8
								D	INFL NO ABORT	9.00	24.7
								M	PERIODI /PHASED INSP	4.77	13.1
								Q	SPECIAL INSPECTION	2.70	7.4
730	LOOSE	28.30	1.2	G	RPR/RPLT MINOR PARTS	23.80	84.1	D	INFLIGHT NO ABORT	22.50	79.5
				Q	INSTALLED	3.50	12.4	F	BETWEEN FLT GND CREW	5.80	20.5
				L	ADJUST	1.00	3.5				
070	BROKEN	23.00	1.0	R	REMOVE AND REPLACE	23.00	100.0	F	BETWEEN FLT GND CREW	22.00	95.7
								H	POST/THRUFLT	1.00	4.3
303	BIRD STRIKE DAMAGE	21.00	0.9	R	REMOVE AND REPLACE	21.00	100.0	C	INFLIGHT ABORT	21.00	100.0
020	WORN CHAFED OR FRAYD	20.79	0.9	G	RPR/RPLT MINOR PARTS	8.43	40.5	F	BETWEEN FLT GND CREW	9.50	45.7
				A	BNCH CK AND REPAIRED	7.50	36.1	M	PERIODIC/PHASED INSP	6.93	33.3
				R	REMOVE AND REPLACE	4.85	23.3	H	POST/THRUFLT	4.35	20.9
108	MISSING BOLTS,NUTS..	20.74	0.9	G	RPR/RPLT MINOR PARTS	19.65	94.7	F	BETWEEN FLT GND CREW	18.59	89.8
				Q	INSTALLED	1.08	5.2	P	FUNCTIONAL CK FLT	1.50	7.2
								M	PERIODIC/PHASED INSP	0.65	3.1
108	BRK/MSG SAFETY WIRE	17.70	0.7	P	REMOVED	17.70	100.0	F	BETWEEN FLT GND CREW	17.70	100.0
334	TEMPERATURE INCORR	16.00	0.7	R	REMOVE AND REPLACE	16.00	100.0	D	INFLIGHT NO ABORT	16.00	100.0
605	CRAZED	14.00	0.6	P	REMOVED	14.00	100.0	F	BETWEEN FLT GND CREW	14.00	100.0
750	MISSING	12.23	0.5	G	RPR/RPLT MINOR PARTS	10.23	83.6	F	BETWEEN FLT GND CREW	5.30	43.3
				Q	INSTALLED	2.00	16.4	M	PERIODIC/PHASED INSP	4.53	37.0
								D	INFLIGHT NO ABORT	2.40	19.6
230	DIRTY CONTAM SATURAT	8.35	0.4	V	CLEAN	8.35	100.0	M	PERIODIC/PHASED INSP	6.78	81.2
								F	BETWEEN FLT GND CREW	0.90	10.8
								L	TRAINING OR MAINTNCE	0.67	8.0
947	TORN	3.67	0.2	A	BNCH CK AND REPAIRED	3.67	100.0	F	BETWEEN FLT GND CREW	3.67	100.0
127	ADJMT/ALGNMT IMPROPR	3.50	0.1	G	RPR/RPLT MINOR PARTS	3.00	85.7	M	PERIODIC/PHASED INSP	3.00	85.7
				L	ADJUST	0.50	14.3	F	BETWEEN FLT GND CREW	0.50	14.3
350	INSULATION BREAKDOWN	2.50	0.1	G	RPR/RPLT MINOR PARTS	2.50	100.0	E	AFTER FLIGHT	2.50	100.0
782	TIRE TREAD DEFECTIVE	2.00	0.1	R	REMOVE AND REPLACE	2.00	100.0	H	POST/THRUFLT	2.00	100.0

Figure A-2. A-7D Design/Cost MAMS (Continued)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

A-07 TRANSPARENCY WUCS ENAC AND SHOP 1/76-6/77 - MARSHALL STA 11-C3 MAR. 16, 1978 PAGE 12

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	153,885	92,035	$168,214	20,038.98	130.21

11ACA W/S GLASS ASSY CTR (CONT.)	$19,599	LSC/ YEAR	PCT OF LSC 10.41	TOTAL	LSC RNK 4	2377.39	MAN HRS	PCT OF MHR 11.86	TOTAL	MHR RNK 4	15.4491 MANHR /1000 FLT HR

HOW MALFUNCTION CODE	NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE	NAME	MAN HOURS	PERCENT OF MMC	WHEN DISCOVERED CODE	NAME	MAN HOURS	PERCENT OF MMC
111	BURST OR RUPTURED	0.33	0.0	X	TEST-INSPECT-SERVICE	0.33	100.0	R	QC CHECK	0.33	100.0
410	LACK OF/IMPROPR LUBE	0.25	0.0	Q	INSTALLED	0.25	100.0	M	PERIODIC/PHASED INSP	0.25	100.0
425	NICKED	0.25	0.0	X	TEST-INSPECT-SERVICE	0.25	100.0	F	BETWEEN FLT GND CREW	0.25	100.0
812	NO DEF-ASSOC EQP MAL	0.00	0.0								

Figure A-2. A-7D Design/Cost MAMS (Concluded)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

C-130 TRANSPARENCY WUCS ONAC AND SHOP 1/76-6/77 - MARSHALL STA 11-C3 MAR. 16, 1978 PAGE 1

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	445,923	472,960	$345,726	28,044.63	62.89

11111 W/S CENTER PANEL $23,125 LSC/YEAR PCT OF LSC 8.14 TOTAL LSC RNK 1 2168.38 MAN HRS PCT OF MHR 7.73 TOTAL MHR RNK 1 4.8627 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF HMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF HMC
190 CRACKED	640.63	29.5	R REMOVE AND REPLACE	442.36	69.1	F BETWEEN FLT GND CREW	247.45	38.6
			P REMOVED	151.77	23.7	D INFLIGHT NO ABORT	169.63	26.5
			Q INSTALLED	42.51	6.6	C INFLIGHT ABORT	138.69	21.6
			A BNCH CK AND REPAIRED	4.00	0.6	H POST/THRUFLT	52.80	8.2
						M PERIODIC/PHASED INSP	28.01	4.4
						K HOURLY POSTFLIGHT	4.00	0.6
799 NO DEFECT	472.55	21.8	Q INSTALLED	439.48	93.0	F BETWEEN FLT GND CREW	244.01	51.6
			H EQUIP CK NO RPR RQRD	29.87	6.3	D INFLIGHT NO ABORT	105.92	22.4
			X TEST-INSPECT-SERVICE	3.20	0.7	K HOURLY POSTFLIGHT	42.11	8.9
						E AFTER FLIGHT	34.78	7.4
						H POST/THRUFLT	29.55	6.3
						M PERIODIC/PHASED INSP	16.00	3.4
						S DEPOT LEVEL MAINTNCE	6.20	0.0
007 ARCING, ARCED	416.64	19.2	R REMOVE AND REPLACE	230.10	55.2	D INFLIGHT NO ABORT	175.42	42.1
			P REMOVED	151.20	36.3	F BETWEEN FLT GND CREW	118.99	28.5
			Q INSTALLED	35.34	8.5	A BEFORE FLT ABORT	55.51	13.3
						H POST/THRUFLT	27.80	6.7
						E AFTER FLIGHT	16.00	3.8
						Q SPECIAL INSPECTION	16.00	3.8
						B BEFORE FLT NO ABORT	6.92	1.7
846 DELAMINATED	249.30	11.5	R REMOVE AND REPLACE	201.29	80.7	K HOURLY POSTFLIGHT	101.02	40.5
			P REMOVED	48.01	19.3	D INFLIGHT NO ABORT	66.01	26.5
						F BETWEEN FLT GND CREW	54.59	21.9
						E AFTER FLIGHT	16.00	6.4
						H POST/THRUFLT	11.67	4.7
070 BROKEN	73.97	3.4	R REMOVE AND REPLACE	48.00	64.9	C INFLIGHT ABORT	32.00	43.3
			P REMOVED	19.80	26.8	F BETWEEN FLT GND CREW	23.00	31.1
			G RPR/RPLT MINOR PARTS	6.17	8.3	H POST/THRUFLT	15.80	21.4
						D INFLIGHT NO ABORT	2.00	2.7
						K HOURLY POSTFLIGHT	1.17	1.8
105 LOOSE/DMGD BOLTS,NUT	67.13	3.1	G RPR/RPLT MINOR PARTS	66.13	98.5	K HOURLY POSTFLIGHT	27.14	40.4
			L ADJUST	1.00	1.5	F BETWEEN FLT GND CREW	22.45	33.4
						M PERIODIC/PHASED INSP	14.87	22.2
						R QC CHECK	1.50	2.2
						D INFLIGHT NO ABORT	1.17	1.7
900 BURNED OR OVERHEATED	37.30	1.7	R REMOVE AND REPLACE	21.30	57.1	F BETWEEN FLT GND CREW	16.00	42.9
			P REMOVED	16.00	42.9	M PERIODIC/PHASED INSP	12.30	33.0
						B BEFORE FLT NO ABORT	9.00	24.1
615 SHORTED	35.26	1.6	R REMOVE AND REPLACE	35.26	100.0	D INFLIGHT NO ABORT	19.25	54.6
						F BETWEEN FLT GND CREW	16.00	45.4

Figure A-3. C-130 Design/Cost MAMS

DESIGN/COST MAINTENANCE ANALYSIS MODEL

C-130 TRANSPARENCY WUCS ONAC AND SHOP 1/76-6/77 - MARSHALL STA 11-03 MAR. 16, 1978 PAGE 2

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	445,923	472,960	$345,726	28,044.63	62.89

11111 W/S CENTER PANEL (CONT.) $28,125 LSC/YEAR | PCT OF LSC TOTAL 8.14 | LSC RNK 1 | 2168.38 MAN HRS | PCT OF MHR TOTAL 7.73 | MHR RNK 1 | 4.8627 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF HMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF HMC
242 FAILED TO OPERATE	27.00	1.2	R REMOVE AND REPLACE	18.00	66.7	F BETWEEN FLT GND CREW	18.00	66.7
			Y TROUBLESHOOT	9.00	33.3	D INFLIGHT NO ABORT	7.50	27.8
						3 HOME STA CK-ISOCHRNL	1.50	5.6
334 TEMPERATURE INCORR	21.00	1.0	R REMOVE AND REPLACE	21.00	100.0	D INFLIGHT NO ABORT	21.00	100.0
605 CRAZED	17.00	0.8	P REMOVED	17.00	100.0	K HOURLY POSTFLIGHT	17.00	100.0
117 DETERIORATED	16.50	0.8	P REMOVED	13.00	78.8	F BETWEEN FLT GND CREW	13.00	78.8
			Q INSTALLED	3.50	21.2	K HOURLY POSTFLIGHT	3.50	21.2
230 DIRTY CONTAM SATUR.T	16.45	0.8	V CLEAN	16.45	100.0	F BETWEEN FLT GND CREW	8.40	51.1
						H POST/THRUFLT	6.05	36.8
						J PREFLIGHT	2.00	12.2
106 MISSING BOLTS,NUTS..	16.00	0.7	R REMOVE AND REPLACE	11.00	68.8	M PERIODIC/PHASED INSP	11.00	68.8
			G RPR/RPLT MINOR PARTS	5.00	31.3	K HOURLY POSTFLIGHT	5.00	31.3
800 NO DEF-RMVD-OTH MAINT	11.30	0.5	R REMOVE AND REPLACE	5.30	46.9	M PERIODIC/PHASED INSP	5.30	46.9
			Q INSTALLED	5.00	44.2	K HOURLY POSTFLIGHT	5.00	44.2
			S REMOVE AND REINSTALL	1.00	8.8	F BETWEEN FLT GND CREW	1.00	8.8
127 ADJMT/ALGNMT IMPROPR	9.34	0.4	L ADJUST	6.50	69.6	F BETWEEN FLT GND CREW	9.34	100.0
			G RPR/RPLT MINOR PARTS	2.83	30.3			
303 BIRD STRIKE DAMAGE	8.00	0.4	P REMOVED	8.00	100.0	F BETWEEN FLT GND CREW	8.00	100.0
805 NO DEF-NOC-OTH MAINT	6.25	0.3	S REMOVE AND REINSTALL	6.25	100.0	F BETWEEN FLT GND CREW	6.25	100.0
111 BURST OR RUPTURED	6.00	0.3	R REMOVE AND REPLACE	6.00	100.0	F BETWEEN FLT GND CREW	6.00	100.0
374 INTERNAL FAILURE	5.25	0.2	R REMOVE AND REPLACE	5.25	100.0	A BEFORE FLT ABORT	5.25	100.0
381 LEAKING INT OR EXT	4.00	0.2	G RPR/RPLT MINOR PARTS	4.00	100.0	D INFLIGHT NO ABORT	2.00	50.0
						F BETWEEN FLT GND CREW	2.00	50.0
865 PROT COAT/SEALNT DEF	3.67	0.2	G RPR/RPLT MINOR PARTS	3.67	100.0	K HOURLY POSTFLIGHT	3.67	100.0
246 IMPROP/FAULTY MAINT	2.33	0.1	G RPR/RPLT MINOR PARTS	2.33	100.0	K HOURLY POSTFLIGHT	2.33	100.0
660 STRIPPED	2.00	0.1	G RPR/RPLT MINOR PARTS	2.00	100.0	F BETWEEN FLT GND CREW	2.00	100.0
730 LOOSE	1.30	0.1	L ADJUST	1.30	100.0	M PERIODIC/PHASED INSP	1.30	100.0
750 MISSING	1.00	0.0	G RPR/RPLT MINOR PARTS	1.00	100.0	F BETWEEN FLT GND CREW	1.00	100.0
170 CORRODED-MILD/MODRTE	0.70	0.0	Z CORROSION REPAIR	0.70	100.0	M PERIODIC/PHASED INSP	0.70	100.0

Figure A-3. C-130 Design/Cost MAMS (Continued)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

C-130 TRANSPARENCY WUCS ONAC AND SHOP 1/76-6/77 - MARSHALL STA 11-C3 MAR. 16, 1978 PAGE 3

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	445,923	472,960	$345,726	28,044.63	62.89

11111 W/S CENTER PANEL (CONT.)	$28,125 LSC/ YEAR	PCT OF LSC 8.14 TOTAL	LSC RNK 1	2168.38 MAN HRS	PCT OF MHR 7.73 TOTAL	MHR RNK 1	4.8627 MANHR /1000 FLT HR
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HOW MALFUNCTION CODE	NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE	NAME	MAN HOURS	PERCENT OF HMC	WHEN DISCOVERED CODE	NAME	MAN HOURS	PERCENT OF HMC
450	OPEN	0.50	0.0	G	RPR/RPLT MINOR PARTS	0.50	100.0	F	BETWEEN FLT GND CREW	0.50	100.0

Figure A-3. C-130 Design/Cost MAMS (Continued)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

C-130 TRANSPARENCY WUCS ONAC AND SHOP 1/76-6/77 - MARSHALL STA 11-C3 MAR. 16, 1978 PAGE 6

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	445,923	472,960	$345,726	28,044.63	62.89

11112 W/S FRONT PANEL RH $21,123 LSC/YEAR | PCT OF LSC 6.11 TOTAL | LSC RNK 3 | 2138.93 MAN HRS | PCT OF MHR 7.63 TOTAL | MHR RNK 2 | 4.7966 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF HMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF HMC
190 CRACKED	693.44	32.4	R REMOVE AND REPLACE	498.95	72.0	D INFLIGHT NO ABORT	263.83	38.0
			P REMOVED	157.98	22.8	F BETWEEN FLT GND CREW	230.09	33.2
			Q INSTALLED	28.01	4.0	H POST/THRUFLT	62.50	9.0
			G RPR/RPLT MINOR PARTS	8.00	1.2	E AFTER FLIGHT	43.00	6.2
			A BNCH CK AND REPAIRED	0.50	0.1	J PREFLIGHT	35.67	5.1
						M PERIODIC/PHASED INSP	24.00	3.5
						A BEFORE FLT ABORT	21.84	3.1
						B BEFORE FLT NO ABORT	8.00	1.2
						S DEPOT LEVEL MAINTNCE	4.00	0.6
						W IN-SHOP REPAIR	0.50	0.1
848 DELAMINATED	362.04	16.9	R REMOVE AND REPLACE	313.69	86.6	F BETWEEN FLT GND CREW	143.19	39.6
			P REMOVED	43.84	12.1	K HOURLY POSTFLIGHT	107.02	29.6
			G RPR/RPLT MINOR PARTS	4.50	1.2	D INFLIGHT NO ABORT	30.70	8.5
						H POST/THRUFLT	29.17	8.1
						M PERIODIC/PHASED INSP	23.00	6.4
						J PREFLIGHT	14.70	4.1
						Q SPECIAL INSPECTION	14.25	3.9
799 NO DEFECT	323.76	15.1	Q INSTALLED	280.51	86.6	F BETWEEN FLT GND CREW	208.80	64.5
			X TEST-INSPECT-SERVICE	9.70	3.0	D INFLIGHT NO ABORT	53.06	16.4
			H EQUIP CK NO RPR RQRD	8.25	2.5	K HOURLY POSTFLIGHT	42.71	13.2
			G RPR/RPLT MINOR PARTS	8.00	2.5	B BEFORE FLT NO ABORT	19.20	5.9
			L ADJUST	6.00	1.9			
			T REMOVE FOR CANIBLZTN	5.00	1.5			
			K CALIBRATD-ADJMT RQRD	3.30	1.0			
			U RPLCD AFTER CANBLZTN	3.00	0.9			
007 ARCING, ARCED	256.17	12.0	R REMOVE AND REPLACE	203.92	79.6	D INFLIGHT NO ABORT	166.36	64.9
			P REMOVED	49.01	19.1	F BETWEEN FLT GND CREW	33.80	13.2
			G RPR/RPLT MINOR PARTS	1.75	0.7	3 HOME STA CK-ISOCHRNL	32.01	12.5
			L ADJUST	1.50	0.6	K HOURLY POSTFLIGHT	24.00	9.4
070 BROKEN	88.52	4.1	R REMOVE AND REPLACE	50.68	57.3	F BETWEEN FLT GND CREW	69.68	78.7
			Q INSTALLED	32.01	36.2	H POST/THRUFLT	16.00	18.1
			G RPR/RPLT MINOR PARTS	5.83	6.6	K HOURLY POSTFLIGHT	2.83	3.2
935 SCORED OR SCRATCHED	70.00	3.3	R REMOVE AND REPLACE	62.00	88.6	D INFLIGHT NO ABORT	62.00	88.6
			P REMOVED	8.00	11.4	F BETWEEN FLT GND CREW	8.00	11.4
605 CRAZED	61.84	2.9	P REMOVED	30.84	49.9	F BETWEEN FLT GND CREW	23.00	37.2
			R REMOVE AND REPLACE	16.00	25.9	K HOURLY POSTFLIGHT	23.00	37.2
			Q INSTALLED	15.00	24.3	H POST/THRUFLT	15.84	25.6
105 LOOSE/DMGD BOLTS,NUT	53.89	2.5	G RPR/RPLT MINOR PARTS	49.14	91.2	F BETWEEN FLT GND CREW	31.80	59.0
			R REMOVE AND REPLACE	4.00	7.4	M PERIODIC/PHASED INSP	8.70	16.1
			L ADJUST	0.75	1.4	K HOURLY POSTFLIGHT	6.25	11.6

Figure A-3. C-130 Design/Cost MAMS (Continued)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

C-130 TRANSPARENCY WUCS ONAC AND SHOP 1/76-6/77 - MARSHALL STA 11-C3 MAR. 16, 1978 PAGE 7

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	445,923	472,960	$345,726	28,044.63	62.89

11112 W/S FRONT PANEL RH (CONT.) $21,123 LSC/YEAR | PCT OF LSC 6.11 TOTAL | LSC RNK 3 | 2138.93 MAN HRS | PCT OF MHR 7.63 TOTAL | MHR RNK 2 | 4.7966 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF HMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF HMC
						S DEPOT LEVEL MAINTNCE	3.00	5.6
						R QC CHECK	2.13	4.0
						D INFLIGHT NO ABORT	2.00	3.7
910 CHIPPED	35.01	1.6	P REMOVED	35.01	100.0	F BETWEEN FLT GND CREW	35.01	100.0
381 LEAKING INT OR EXT	27.00	1.3	G RPR/RPLT MINOR PARTS	27.00	100.0	F BETWEEN FLT GND CREW	27.00	100.0
242 FAILED TO OPERATE	24.00	1.1	Q INSTALLED	24.00	100.0	F BETWEEN FLT GND CREW	24.00	100.0
800 NO DEF-RMVD-OTH MAINT	23.25	1.1	Q INSTALLED	22.00	94.6	D INFLIGHT NO ABORT	16.00	68.8
			P REMOVED	1.25	5.4	H POST/THRUFLT	6.00	25.8
						K HOURLY POSTFLIGHT	1.25	5.4
900 BURNED OR OVERHEATED	22.50	1.1	R REMOVE AND REPLACE	16.00	71.1	D INFLIGHT NO ABORT	22.50	100.0
			P REMOVED	4.50	20.0			
			Y TROUBLESHOOT	2.00	8.9			
805 NO DEF-NOC-OTH MAINT	21.34	1.0	R REMOVE AND REPLACE	16.00	75.0	D INFLIGHT NO ABORT	18.50	86.7
			G RPR/RPLT MINOR PARTS	2.83	13.3	F BETWEEN FLT GND CREW	2.83	13.3
			Q INSTALLED	2.50	11.7			
996 RF TERMINAL OVERHEAT	21.30	1.0	P REMOVED	21.30	100.0	H POST/THRUFLT	21.30	100.0
127 ADJMT/ALGNMT IMPROPR	17.17	0.8	L ADJUST	16.67	97.1	F BETWEEN FLT GND CREW	9.33	54.3
			G RPR/RPLT MINOR PARTS	0.50	2.9	3 HOME STA CK-ISOCHRNL	3.83	22.3
						D INFLIGHT NO ABORT	2.50	14.6
						M PERIODIC/PHASED INSP	1.00	5.8
						K HOURLY POSTFLIGHT	0.50	2.9
108 MISSING BOLTS,NUTS..	10.40	0.5	G RPR/RPLT MINOR PARTS	10.40	100.0	K HOURLY POSTFLIGHT	7.00	67.3
						F BETWEEN FLT GND CREW	3.00	28.8
						M PERIODIC/PHASED INSP	0.40	3.8
117 DETERIORATED	8.50	0.4	G RPR/RPLT MINOR PARTS	8.50	100.0	F BETWEEN FLT GND CREW	8.00	94.1
						K HOURLY POSTFLIGHT	0.50	5.9
246 IMPROP/FAULTY MAINT	4.67	0.2	G RPR/RPLT MINOR PARTS	4.67	100.0	K HOURLY POSTFLIGHT	4.67	100.0
667 CORRODED-SEVERE	3.83	0.2	R REMOVE AND REPLACE	2.83	73.9	K HOURLY POSTFLIGHT	3.83	100.0
			A BNCH CK AND REPAIRED	1.00	26.1			
730 LOOSE	3.50	0.2	G RPR/RPLT MINOR PARTS	2.00	57.1	F BETWEEN FLT GND CREW	2.00	57.1
			F REPAIR	1.50	42.9	3 HOME STA CK-ISOCHRNL	1.50	42.9
167 TORQUE INCORRECT	2.00	0.1	L ADJUST	2.00	100.0	D INFLIGHT NO ABORT	2.00	100.0
230 DIRTY CONTAM SATURAT	2.00	0.1	G RPR/RPLT MINOR PARTS	2.00	100.0	K HOURLY POSTFLIGHT	2.00	100.0

Figure A-3. C-130 Design/Cost MAMS (Continued)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

C-130 TRANSPARENCY WUCS ONAC AND SHOP 1/76-6/77 - MARSHALL STA 11-C3 MAR. 16, 1976 PAGE 8

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	445,923	472,960	$345,726	28,044.63	62.89

11112 W/S FRONT PANEL RH (CONT.)	$21,123	LSC/ YEAR	PCT OF LSC 6.11	TOTAL	LSC RNK 3	2138.93	MAN HRS	PCT OF MHR 7.63	TOTAL	MHR RNK 2	4.7966 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF HMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF HMC
303 BIRD STRIKE DAMAGE	2.00	0.1	P REMOVED	2.00	100.0	D INFLIGHT NO ABORT	2.00	100.0
750 MISSING	0.50	0.0	G RPR/RPLT MINOR PARTS	0.50	100.0	M PERIODIC/PHASED INSP	0.50	100.0
080 DEFECTIVE LAMP/METER	0.30	0.0	R REMOVE AND REPLACE	0.30	100.0	K HOURLY POSTFLIGHT	0.30	100.0

Figure A-3. C-130 Design/Cost MAMS (Continued)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

C-130 TRANSPARENCY WUCS ONAC AND SHOP 1/76-6/77 - MARSHALL STA 11-C3 MAR. 16, 1978 PAGE 23

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	445,893	472,960	$345,726	28,044.63	62.89

1119K W/S FRONT PANEL LH $16,872 LSC/YEAR | PCT OF LSC 4.88 TOTAL | LSC RNK 8 | 1397.78 MAN HRS | PCT OF MHR 4.98 TOTAL | MHR RNK 6 | 3.1346 MANHR/1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF HMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF HMC
166 CRACKED	485.68	34.7	R REMOVE AND REPLACE	400.60	82.5	F BETWEEN FLT GND CREW	167.16	34.4
			P REMOVED	67.31	13.9	D INFLIGHT NO ABORT	144.32	29.7
			G RPR/RPLT MINOR PARTS	16.75	3.4	M PERIODIC/PHASED INSP	72.00	14.8
			Q INSTALLED	1.00	0.2	K HOURLY POSTFLIGHT	48.76	10.0
						A BEFORE FLT ABORT	29.92	6.2
						H POST/THRUFLT	12.00	2.5
						C INFLIGHT ABORT	11.50	2.4
848 DELAMINATED	351.45	25.1	R REMOVE AND REPLACE	187.24	53.3	F BETWEEN FLT GND CREW	158.47	45.1
			P REMOVED	96.01	27.3	K HOURLY POSTFLIGHT	129.63	36.9
			Q INSTALLED	68.21	19.4	J PREFLIGHT	32.01	9.1
						M PERIODIC/PHASED INSP	23.25	6.6
						H POST/THRUFLT	7.90	2.2
799 NO DEFECT	148.73	10.7	Q INSTALLED	136.18	91.0	F BETWEEN FLT GND CREW	59.58	39.1
			X TEST-INSPECT-SERVICE	9.25	6.2	M PERIODIC/PHASED INSP	45.17	30.2
			H EQUIP CK NO RPR RQRD	4.30	2.9	D INFLIGHT NO ABORT	33.20	22.2
						K HOURLY POSTFLIGHT	10.17	6.8
						J HOME STA CK-ISOCHRNL	2.00	1.3
						S DEPOT LEVEL MAINTNCE	0.60	0.4
007 ARCING, ARCED	115.76	8.3	R REMOVE AND REPLACE	89.06	76.9	H POST/THRUFLT	50.00	43.2
			P REMOVED	26.70	23.1	Q QC CHECK	34.01	29.4
						K HOURLY POSTFLIGHT	15.75	13.6
						F BETWEEN FLT GND CREW	10.00	8.8
						D INFLIGHT NO ABORT	6.00	5.2
935 SCORED OR SCRATCHED	81.51	4.4	R REMOVE AND REPLACE	29.50	48.0	F BETWEEN FLT GND CREW	32.01	52.0
			F REPAIR	16.00	26.0	D INFLIGHT NO ABORT	24.00	39.0
			P REMOVED	14.00	22.8	H POST/THRUFLT	5.50	8.9
			V CLEAN	2.00	3.3			
605 CRAZED	42.51	3.0	R REMOVE AND REPLACE	36.51	85.9	H POST/THRUFLT	23.50	55.3
			P REMOVED	6.00	14.1	F BETWEEN FLT GND CREW	13.00	30.6
						D INFLIGHT NO ABORT	6.00	14.1
361 LEAKING INT OR EXT	28.41	2.0	G RPR/RPLT MINOR PARTS	28.41	100.0	F BETWEEN FLT GND CREW	27.01	95.1
						K HOURLY POSTFLIGHT	1.40	4.9
998 RF TERMINAL OVERHEAT	27.70	2.0	R REMOVE AND REPLACE	27.70	100.0	H POST/THRUFLT	27.70	100.0
165 LOOSE/DMGD BOLTS,NUT	25.65	1.8	G RPR/RPLT MINOR PARTS	21.65	84.4	K HOURLY POSTFLIGHT	10.65	41.4
			L ADJUST	4.00	15.6	F BETWEEN FLT GND CREW	9.42	36.8
						M PERIODIC/PHASED INSP	5.60	21.8
						D INFLIGHT NO ABORT	1.00	3.9
070 BROKEN	23.04	1.6	R REMOVE AND REPLACE	12.34	53.6	F BETWEEN FLT GND CREW	21.34	92.6

Figure A-3. C-130 Design/Cost MAMS (Continued)

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	445,523	472,960	$345,726	28,044.63	62.89

1111K W/S FRONT PANEL LH (CONT.) $16,872 LSC/YEAR | PCT OF LSC 4.88 | LSC RNK TOTAL 9 | 1397.78 MAN HRS | PCT OF MHR 4.98 | MHR RNK TOTAL 6 | 3.1346 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF HMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF HMC
			A BNCH CK AND REPAIRED	9.00	39.1	K HOURLY POSTFLIGHT	1.00	4.3
			G RPR/RPLT MINOR PARTS	1.70	7.4	M PERIODIC/PHASED INSP	0.70	3.0
805 NO DEF-NOC-OTH MAINT	18.67	1.3	Q INSTALLED	14.50	77.7	C INFLIGHT ABORT	18.67	100.0
			P REMOVED	4.17	22.3			
117 DETERIORATED	16.00	1.1	R REMOVE AND REPLACE	16.00	100.0	K HOURLY POSTFLIGHT	16.00	100.0
127 ADJMT/ALGNMT IMPROPR	10.33	0.7	G RPR/RPLT MINOR PARTS	5.25	50.8	F BETWEEN FLT GND CREW	5.08	49.2
			L ADJUST	5.08	49.2	D INFLIGHT NO ABORT	4.00	38.7
						K HOURLY POSTFLIGHT	1.25	12.1
106 MISSING BOLTS,NUTS	7.05	0.5	G RPR/RPLT MINOR PARTS	7.05	100.0	F BETWEEN FLT GND CREW	3.50	49.6
						K HOURLY POSTFLIGHT	2.30	32.8
						M PERIODIC/PHASED INSP	1.25	17.7
730 LOOSE	6.13	0.4	L ADJUST	4.00	65.3	F BETWEEN FLT GND CREW	4.00	65.3
			G RPR/RPLT MINOR PARTS	2.13	34.7	R QC CHECK	1.00	16.3
						K HOURLY POSTFLIGHT	0.83	13.5
						M PERIODIC/PHASED INSP	0.30	4.9
374 INTERNAL FAILURE	6.00	0.4	R REMOVE AND REPLACE	6.00	100.0	D INFLIGHT NO ABORT	6.00	100.0
242 FAILED TO OPERATE	5.00	0.4	R REMOVE AND REPLACE	5.00	100.0	B BEFORE FLT NO ABORT	5.00	100.0
667 CORRODED-SEVERE	5.00	0.4	G RPR/RPLT MINOR PARTS	5.00	100.0	M PERIODIC/PHASED INSP	5.00	100.0
800 NO DEF-RMVD-OTH MAINT	4.17	0.3	P REMOVED	4.17	100.0	F BETWEEN FLT GND CREW	4.17	100.0
020 WORN CHAFED OR FRAYD	3.00	0.2	G RPR/RPLT MINOR PARTS	3.00	100.0	F BETWEEN FLT GND CREW	3.00	100.0
170 CORRODED-MILD/MODRTE	2.00	0.1	G RPR/RPLT MINOR PARTS	2.00	100.0	K HOURLY POSTFLIGHT	2.00	100.0
865 PROT COAT/SEALNT DEF	2.00	0.1	G RPR/RPLT MINOR PARTS	2.00	100.0	D INFLIGHT NO ABORT	2.00	100.0
230 DIRTY CONTAM SATURAT	1.00	0.1	V CLEAN	1.00	100.0	K HOURLY POSTFLIGHT	1.00	100.0

Figure A-3. C-130 Design/Cost MAMS (Continued)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

C-130 TRANSPARENCY MUCS ONAC AND SHOP 1/76-6/77 - MARSHALL STA 11-C3 MAR. 16, 1978 PAGE 32

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	445,923	472,960	$345,726	28,044.63	62.89

11115 W/S CLEAR VISION RH — $9,723 LSC/YEAR — PCT OF LSC 2.81 TOTAL — LSC RNK 13 — 634.47 MAN HRS — PCT OF MHR 2.26 TOTAL — MHR RNK 19 — 1.4228 MANHR/1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF MUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF MMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF MMC
190 CRACKED	181.80	28.7	R REMOVE AND REPLACE	85.18	46.9	F BETWEEN FLT GND CREW	62.18	34.2
			F REPAIR	60.01	33.0	M PERIODIC/PHASED INSP	60.01	33.0
			P REMOVED	25.60	14.1	D INFLIGHT NO ABORT	42.01	23.1
			G RPR/RPLT MINOR PARTS	11.00	6.1	S DEPOT LEVEL MAINTNCE	10.00	5.5
						B BEFORE FLT NO ABORT	6.60	3.6
						3 HOME STA CK-ISOCHRNL	1.00	0.6
799 NO DEFECT	92.35	14.6	Q INSTALLED	32.34	35.0	F BETWEEN FLT GND CREW	50.71	54.9
			U RPLCD AFTER CANBLZTN	25.84	28.0	D INFLIGHT NO ABORT	22.30	24.1
			T REMOVE FOR CANIBLZTN	20.17	21.8	K HOURLY POSTFLIGHT	15.34	16.6
			P REMOVED	12.00	13.0	H POST/THRUFLT	2.00	2.2
			H EQUIP CK NO RPR RQRD	2.00	2.2	M PERIODIC/PHASED INSP	2.00	2.2
846 DELAMINATED	67.60	10.7	R REMOVE AND REPLACE	29.09	43.0	F BETWEEN FLT GND CREW	30.59	45.3
			P REMOVED	20.00	29.6	H POST/THRUFLT	24.00	35.5
			Q INSTALLED	18.50	27.4	J PREFLIGHT	13.00	19.2
070 BROKEN	42.56	6.7	Q INSTALLED	30.01	70.5	F BETWEEN FLT GND CREW	33.01	77.6
			R REMOVE AND REPLACE	12.30	28.9	C INFLIGHT ABORT	7.30	17.2
			9 BNCH CK-CONDENNED	0.25	0.6	J PREFLIGHT	2.00	4.7
						K HOURLY POSTFLIGHT	0.25	0.6
605 CRAZED	39.40	6.2	R REMOVE AND REPLACE	39.40	100.0	F BETWEEN FLT GND CREW	24.00	60.9
						S DEPOT LEVEL MAINTNCE	15.40	39.1
900 BURNED OR OVERHEATED	35.00	5.5	R REMOVE AND REPLACE	35.00	100.0	D INFLIGHT NO ABORT	35.00	100.0
242 FAILED TO OPERATE	24.50	3.8	R REMOVE AND REPLACE	24.50	100.0	F BETWEEN FLT GND CREW	24.50	100.0
117 DETERIORATED	20.47	3.2	R REMOVE AND REPLACE	12.75	62.3	K HOURLY POSTFLIGHT	12.75	62.3
			G RPR/RPLT MINOR PARTS	7.72	37.7	F BETWEEN FLT GND CREW	4.80	23.4
						H POST/THRUFLT	1.92	9.4
						3 HOME STA CK-ISOCHRNL	1.00	4.9
105 LOOSE/DMGD BOLTS,NUT	20.05	3.2	G RPR/RPLT MINOR PARTS	18.22	90.9	M PERIODIC/PHASED INSP	10.80	53.9
			L ADJUST	1.83	9.1	F BETWEEN FLT GND CREW	8.25	41.1
						S DEPOT LEVEL MAINTNCE	1.00	5.0
615 SHORTED	15.80	2.5	R REMOVE AND REPLACE	11.80	74.7	F BETWEEN FLT GND CREW	11.80	74.7
			9 BNCH CK-CONDENNED	4.00	25.3	H POST/THRUFLT	4.00	25.3
020 WORN CHAFED OR FRAYD	15.50	2.4	G RPR/RPLT MINOR PARTS	15.00	96.8	F BETWEEN FLT GND CREW	15.00	96.8
			R REMOVE AND REPLACE	0.50	3.2	J PREFLIGHT	0.50	3.2
108 MISSING BOLTS,NUTS..	14.50	2.3	G RPR/RPLT MINOR PARTS	14.50	100.0	K HOURLY POSTFLIGHT	9.50	65.5
						F BETWEEN FLT GND CREW	2.50	17.2
						M PERIODIC/PHASED INSP	2.50	17.2

Figure A-3. C-130 Design/Cost MAMS (Continued)

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	445,923	472,960	$345,726	28,044.63	62.89

11115 W/S CLEAR VISION RH (CONT.) — $9,723 LSC/YEAR; PCT OF LSC TOTAL 2.81; LSC RNK 13; 634.47 MAN HRS; PCT OF MHR TOTAL 2.26; MHR RNK 19; 1.4228 MANHR/1000 FLT HR

HOW MALFUNCTION CODE	NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE	NAME	MAN HOURS	PERCENT OF HMC	WHEN DISCOVERED CODE	NAME	MAN HOURS	PERCENT OF HMC
127	ADJMT/ALGNMT IMPROPR	12.72	2.0	L	ADJUST	8.97	70.5	F	BETWEEN FLT GND CREW	8.17	64.2
				G	RPR/RPLT MINOR PARTS	3.75	29.5	K	HOUPLY POSTFLIGHT	3.75	29.5
								D	INFLIGHT NO ABORT	0.80	6.3
007	ARCING, ARCED	9.30	1.5	P	REMOVED	9.30	100.0	F	BETWEEN FLT GND CREW	9.30	100.0
721	IMPROP RESP-ELEC IPT	7.83	1.2	R	REMOVE AND REPLACE	7.83	100.0	J	PREFLIGHT	7.83	100.0
381	LEAKING INT OR EXT	7.15	1.1	G	RPR/RPLT MINOR PARTS	7.15	100.0	F	BETWEEN FLT GND CREW	4.00	55.9
								H	POST/THRUFLT	1.90	26.6
								K	HOURLY POSTFLIGHT	1.25	17.5
878	WEATHER DAMAGE	6.80	1.1	G	RPR/RPLT MINOR PARTS	6.80	100.0	F	BETWEEN FLT GND CREW	6.80	100.0
246	IMPROP/FAULTY MAINT	5.30	0.8	G	RPR/RPLT MINOR PARTS	5.30	100.0	M	PERIODIC/PHASED INSP	5.30	100.0
667	CORRODED-SEVERE	4.00	0.6	F	REPAIR	4.00	100.0	M	PERIODIC/PHASED INSP	4.00	100.0
300	GROUNDED ELECTRICALY	3.00	0.5	R	REMOVE AND REPLACE	3.00	100.0	D	INFLIGHT NO ABORT	3.00	100.0
780	BENT,BUCKLED,COLLASP	2.00	0.3	G	RPR/RPLT MINOR PARTS	2.00	100.0	K	HOURLY POSTFLIGHT	2.00	100.0
935	SCORED OR SCRATCHED	1.50	0.2	R	REMOVE AND REPLACE	1.50	100.0	M	PERIODIC/PHASED INSP	1.50	100.0
730	LOOSE	1.33	0.2	G	RPR/RPLT MINOR PARTS	1.33	100.0	K	HOURLY POSTFLIGHT	1.33	100.0
170	CORRODED-MILD/MODRTE	1.25	0.2	Z	CORROSION REPAIR	1.25	100.0	M	PERIODIC/PHASED INSP	1.25	100.0
805	NO DEF-NOC-OTH MAINT	1.25	0.2	G	RPR/RPLT MINOR PARTS	1.25	100.0	K	HOURLY POSTFLIGHT	1.25	100.0
804	NO DEF-SCH MAINT/MOD	1.00	0.2	G	RPR/RPLT MINOR PARTS	1.00	100.0	F	BETWEEN FLT GND CREW	1.00	100.0
750	MISSING	0.50	0.1	G	RPR/RPLT MINOR PARTS	0.50	100.0	M	PERIODIC/PHASED INSP	0.50	100.0

Figure A-3. C-130 Design/Cost MAMS (Continued)

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	448,923	472,960	$346,726	28,044.83	62.49

1111N W/S CLEAR VISION LH — $9,141 LSC/YEAR — PCT OF LSC 2.64 TOTAL — LSC RNK 15 — 820.80 MAN HRS — PCT OF MHR 2.93 TOTAL — MHR RNK 16 — 1.8407 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF HMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF HMC
799 NO DEFECT	154.35	18.8	Q INSTALLED	101.65	65.9	F BETWEEN FLT GND CREW	88.24	57.2
			U RPLCD AFTER CANBLZTN	26.20	17.0	K HOURLY POSTFLIGHT	37.10	24.0
			T REMOVE FOR CANIBLZTN	9.00	5.8	D INFLIGHT NO ABORT	17.00	11.0
			R REMOVE AND REPLACE	8.00	5.2	M PERIODIC/PHASED INSP	6.75	4.4
			H EQUIP CK NO RPR RQRD	7.50	4.9	P FUNCTIONAL CK FLT	5.25	3.4
			X TEST-INSPECT-SERVICE	2.00	1.3			
070 BROKEN	139.53	17.0	R REMOVE AND REPLACE	104.02	74.6	J PREFLIGHT	96.02	68.8
			P REMOVED	31.01	22.2	D INFLIGHT NO ABORT	36.01	25.8
			Q INSTALLED	3.00	2.2	H POST/THRUFLT	4.50	3.2
			G RPR/RPLT MINOR PARTS	1.50	1.1	F BETWEEN FLT GND CREW	3.00	2.2
180 CRACKED	125.75	15.3	R REMOVE AND REPLACE	106.41	84.6	F BETWEEN FLT GND CREW	65.94	52.4
			P REMOVED	10.50	8.3	H POST/THRUFLT	27.80	22.1
			G RPR/RPLT MINOR PARTS	6.00	4.8	D INFLIGHT NO ABORT	20.00	15.9
			Q INSTALLED	2.50	2.0	S DEPOT LEVEL MAINTNCE	9.00	7.2
			9 BNCH CK-CONDENNED	0.33	0.3	C INFLIGHT ABORT	3.00	2.4
007 ARCING, ARCED	79.31	9.7	R REMOVE AND REPLACE	64.31	81.1	M PERIODIC/PHASED INSP	27.30	34.4
			P REMOVED	15.00	18.9	F BETWEEN FLT GND CREW	27.00	34.0
						D INFLIGHT NO ABORT	19.00	24.0
						B BEFORE FLT NO ABORT	6.00	7.6
848 DELAMINATED	74.88	9.1	R REMOVE AND REPLACE	59.68	79.7	D INFLIGHT NO ABORT	44.96	60.0
			P REMOVED	15.20	20.3	F BETWEEN FLT GND CREW	19.92	26.6
						M PERIODIC/PHASED INSP	7.00	9.3
						K HOURLY POSTFLIGHT	3.00	4.0
381 LEAKING INT OR EXT	35.58	4.3	G RPR/RPLT MINOR PARTS	35.58	100.0	F BETWEEN FLT GND CREW	26.00	73.1
						H POST/THRUFLT	6.92	19.4
						D INFLIGHT NO ABORT	1.42	4.0
						K HOURLY POSTFLIGHT	1.25	3.5
108 MISSING BOLTS,NUTS..	32.22	3.9	G RPR/RPLT MINOR PARTS	29.22	90.7	F BETWEEN FLT GND CREW	20.30	63.0
			A BNCH CK AND REPAIRED	3.00	9.3	M PERIODIC/PHASED INSP	10.00	31.0
						K HOURLY POSTFLIGHT	1.75	5.4
						H POST/THRUFLT	0.17	0.5
020 WORN CHAFED OR FRAYD	28.50	3.5	G RPR/RPLT MINOR PARTS	28.00	98.2	F BETWEEN FLT GND CREW	24.00	84.2
			R REMOVE AND REPLACE	0.50	1.8	H POST/THRUFLT	4.00	14.0
						J PREFLIGHT	0.50	1.8
242 FAILED TO OPERATE	27.92	3.4	P REMOVED	16.00	57.3	J PREFLIGHT	20.92	74.9
			Q INSTALLED	11.92	42.7	F BETWEEN FLT GND CREW	7.00	25.1
105 LOOSE/DMGD BOLTS,NUT	25.25	3.1	G RPR/RPLT MINOR PARTS	21.25	84.2	K HOURLY POSTFLIGHT	11.08	43.9
			R REMOVE AND REPLACE	4.00	15.8	F BETWEEN FLT GND CREW	8.17	32.4

Figure A-3. C-130 Design/Cost MAMS (Continued)

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	445,923	472,960	$345,726	28,044.63	62.89

1111N W/S CLEAR VISION LH (CONT.) — $9,141 LSC/YEAR; PCT OF LSC TOTAL 2.64; LSC RNK 15; 820.80 MAN HRS; PCT OF MHR TOTAL 2.93; MHR RNK 16; 1.8407 MANHR/1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF HMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF HMC
						M PERIODIC/PHASED INSP	6.00	23.8
117 DETERIORATED	20.89	2.5	G RPR/RPLT MINOR PARTS	11.89	56.9	F BETWEEN FLT GND CREW	10.30	49.3
			P REMOVED	8.00	38.3	K HOURLY POSTFLIGHT	9.00	43.1
			R REMOVE AND REPLACE	1.00	4.8	H POST/THRUFLT	1.58	7.6
605 CRAZED	18.00	2.2	R REMOVE AND REPLACE	10.00	55.6	J PREFLIGHT	10.00	55.6
			P REMOVED	8.00	44.4	F BETWEEN FLT GND CREW	8.00	44.4
127 ADJMT/ALGNMT IMPROPR	11.22	1.4	L ADJUST	10.22	91.1	M PERIODIC/PHASED INSP	9.00	80.2
			G RPR/RPLT MINOR PARTS	1.00	8.9	D INFLIGHT NO ABORT	1.55	13.8
						F BETWEEN FLT GND CREW	0.67	6.0
615 SHORTED	11.00	1.3	R REMOVE AND REPLACE	11.00	100.0	D INFLIGHT NO ABORT	11.00	100.0
169 INCORRECT VOLTAGE	8.50	1.0	R REMOVE AND REPLACE	8.50	100.0	M PERIODIC/PHASED INSP	8.50	100.0
800 NO DEF-RMVD-OTH MAINT	8.50	1.0	Q INSTALLED	8.50	100.0	F BETWEEN FLT GND CREW	4.50	52.9
						K HOURLY POSTFLIGHT	4.00	47.1
884 LEAD BROKEN	8.50	1.0	G RPR/RPLT MINOR PARTS	8.50	100.0	A BEFORE FLT ABORT	8.50	100.0
374 INTERNAL FAILURE	3.10	0.4	R REMOVE AND REPLACE	3.10	100.0	F BETWEEN FLT GND CREW	3.10	100.0
730 LOOSE	2.50	0.3	G RPR/RPLT MINOR PARTS	2.50	100.0	M PERIODIC/PHASED INSP	2.00	80.0
						R QC CHECK	0.50	20.0
160 CONTACTS/CONN DEFECT	2.33	0.3	G RPR/RPLT MINOR PARTS	2.33	100.0	B BEFORE FLT NO ABORT	2.33	100.0
750 MISSING	1.50	0.2	Q INSTALLED	1.00	66.7	F BETWEEN FLT GND CREW	1.00	66.7
			G RPR/RPLT MINOR PARTS	0.50	33.3	M PERIODIC/PHASED INSP	0.50	33.3
780 BENT,BUCKLED,COLLASP	0.67	0.1	G RPR/RPLT MINOR PARTS	0.67	100.0	M PERIODIC/PHASED INSP	0.67	100.0
947 TORN	0.50	0.1	G RPR/RPLT MINOR PARTS	0.50	100.0	F BETWEEN FLT GND CREW	0.50	100.0
248 IMPROP/FAULTY MAINT	0.30	0.0	G RPR/RPLT MINOR PARTS	0.30	100.0	M PERIODIC/PHASED INSP	0.30	100.0

Figure A-3. C-130 Design/Cost MAMS (Concluded)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

H-53 TRANSPARENCY WUCS ONAC AND SHOP 1/76-10/76 - MARSHALL STA 11-C3 MAR. 16, 1978 PAGE 3

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	8,193	16,436	$52,947	1,943.59	237.22

1111B WINDSHIELD ASSY LH — $8,181 LSC/YEAR — PCT OF LSC 15.45 TOTAL — LSC RNK 2 — 406.50 MAN HRS — PCT OF MHR 20.91 TOTAL — MHR RNK 3 — 49.6155 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF HMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF HMC
190 CRACKED	102.00	25.1	R REMOVE AND REPLACE	44.00	43.1	F BETWEEN FLT GND CREW	79.00	77.5
			G RPR/RPLT MINOR PARTS	40.00	39.2	M PERIODIC/PHASED INSP	23.00	22.5
			P REMOVED	10.00	9.8			
			F REPAIR	8.00	7.8			
605 CRAZED	62.20	15.3	R REMOVE AND REPLACE	58.20	93.6	J PREFLIGHT	28.00	45.0
			P REMOVED	4.00	6.4	F BETWEEN FLT GND CREW	24.00	38.6
						M PERIODIC/PHASED INSP	10.20	16.4
935 SCORED OR SCRATCHED	48.50	11.9	R REMOVE AND REPLACE	21.00	43.3	F BETWEEN FLT GND CREW	20.00	41.2
			V CLEAN	8.00	16.5	M PERIODIC/PHASED INSP	16.50	34.0
			G RPR/RPLT MINOR PARTS	7.50	15.5	J PREFLIGHT	8.00	16.5
			P REMOVED	7.00	14.4	H POST/THRUFLT	4.00	8.2
			Q INSTALLED	5.00	10.3			
848 DELAMINATED	43.00	10.6	R REMOVE AND REPLACE	35.00	81.4	F BETWEEN FLT GND CREW	40.00	93.0
			G RPR/RPLT MINOR PARTS	8.00	18.6	M PERIODIC/PHASED INSP	3.00	7.0
105 LOOSE/DMGD BOLTS,NUT	38.00	9.3	G RPR/RPLT MINOR PARTS	38.00	100.0	M PERIODIC/PHASED INSP	25.40	66.8
						F BETWEEN FLT GND CREW	12.60	33.2
106 MISSING BOLTS,NUTS..	29.50	7.3	G RPR/RPLT MINOR PARTS	29.50	100.0	M PERIODIC/PHASED INSP	18.00	61.0
						F BETWEEN FLT GND CREW	11.50	39.0
127 ADJMT/ALGNMT IMPROPR	17.00	4.2	G RPR/RPLT MINOR PARTS	17.00	100.0	M PERIODIC/PHASED INSP	17.00	100.0
070 BROKEN	16.00	3.9	R REMOVE AND REPLACE	15.00	93.8	H POST/THRUFLT	9.00	56.3
			G RPR/RPLT MINOR PARTS	1.00	6.3	D INFLIGHT NO ABORT	4.00	25.0
						F BETWEEN FLT GND CREW	2.00	12.5
						M PERIODIC/PHASED INSP	1.00	6.3
780 BENT,BUCKLED,COLLASP	10.00	2.5	R REMOVE AND REPLACE	10.00	100.0	J PREFLIGHT	10.00	100.0
111 BURST OR RUPTURED	8.00	2.0	R REMOVE AND REPLACE	8.00	100.0	F BETWEEN FLT GND CREW	8.00	100.0
160 CONTACTS/CONN DEFECT	8.00	2.0	R REMOVE AND REPLACE	8.00	100.0	M PERIODIC/PHASED INSP	8.00	100.0
230 DIRTY CONTAM SATURAT	7.80	1.9	G RPR/RPLT MINOR PARTS	4.00	51.3	M PERIODIC/PHASED INSP	5.80	74.4
			V CLEAN	3.80	48.7	R QC CHECK	2.00	25.6
865 PROT COAT/SEALNT DEF	5.00	1.2	G RPR/RPLT MINOR PARTS	5.00	100.0	M PERIODIC/PHASED INSP	5.00	100.0
246 IMPROP/FAULTY MAINT	2.50	0.6	G RPR/RPLT MINOR PARTS	2.50	100.0	F BETWEEN FLT GND CREW	2.00	80.0
						M PERIODIC/PHASED INSP	0.50	20.0
860 STRIPPED	2.50	0.6	G RPR/RPLT MINOR PARTS	2.50	100.0	H POST/THRUFLT	2.50	100.0

Figure A-4. CH-53 Design/Cost MAMS

DESIGN/COST MAINTENANCE ANALYSIS MODEL

H-53 TRANSPARENCY MUCS ONAC AND SHOP 1/76-10/76 - MARSHALL SFA 11-C3 MAR. 16, 1978 PAGE 4

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	8,193	16,436	$52,947	1,943.59	237.22

11118 WINDSHIELD ASSY LH (CONT.) $8,161 LSC/YEAR PCT OF LSC 15.45 LSC RNK 2 406.50 MAN HRS PCT OF MHR 20.91 MHR RNK 3 49.5155 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF MUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF MAC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF MAC
800 NO DEF-RCVD-OTH MAINT	2.20	0.5	P REMOVED	2.20	100.0	F BETWEEN FLT GND CREW	2.20	100.0
585 SHEARED	2.00	0.5	G RPR/RPLT MINOR PARTS	2.00	100.0	F BETWEEN FLT GND CREW	2.00	100.0
117 DETERIORATED	1.30	0.4	R REMOVE AND REPLACE	1.00	55.6	M PERIODIC/PHASED INSP	1.00	55.6
			G RPR/RPLT MINOR PARTS	0.80	44.4	M POST/THRUFLT	0.80	44.4
170 CORRODED-MILD/MODRTE	0.50	0.1	Z CORROSION REPAIR	0.50	100.0	M PERIODIC/PHASED INSP	0.50	100.0

Figure A-4. CH-53 Design/Cost MAMS (Continued)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

H-53 TRANSPARENCY WUCS ONAC AND SHOP 1/76-10/76 - MARSHALL STA 11-C3 MAR. 16, 1978 PAGE 5

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	8,193	16,436	$52,947	1,943.59	237.22

1111C WINDSHIELD ASSY RH — $7,104 LSC/YEAR — PCT OF LSC 13.42 TOTAL — LSC RNK 3 — 412.30 MAN HRS — PCT OF MHR 21.21 TOTAL — MHR RNK 2 — 50.3234 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF HMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF HMC
190 CRACKED	103.00	25.0	R REMOVE AND REPLACE	64.00	62.1	J PREFLIGHT	33.00	32.0
			G RPR/RPLT MINOR PARTS	23.00	22.3	F BETWEEN FLT GND CREW	26.00	25.2
			P REMOVED	16.00	15.5	S DEPOT LEVEL MAINTNCE	18.50	18.0
						M PERIODIC/PHASED INSP	12.80	12.4
						H POST/THRUFLT	12.70	12.3
605 CRAZED	64.20	15.8	R REMOVE AND REPLACE	32.20	50.2	F BETWEEN FLT GND CREW	58.00	90.3
			G RPR/RPLT MINOR PARTS	32.00	49.8	M PERIODIC/PHASED INSP	6.20	9.7
935 SCORED OR SCRATCHED	41.80	10.1	R REMOVE AND REPLACE	38.00	90.9	F BETWEEN FLT GND CREW	22.50	53.8
			P REMOVED	3.80	9.1	D INFLIGHT NO ABORT	13.80	33.0
						M PERIODIC/PHASED INSP	5.50	13.2
105 LOOSE/DMGD BOLTS,NUT	36.60	8.9	G RPR/RPLT MINOR PARTS	36.60	100.0	M PERIODIC/PHASED INSP	23.00	62.8
						F BETWEEN FLT GND CREW	13.60	37.2
848 DELAMINATED	31.10	7.5	R REMOVE AND REPLACE	31.10	100.0	F BETWEEN FLT GND CREW	31.10	100.0
780 BENT,BUCKLED,COLLASP	18.50	4.5	R REMOVE AND REPLACE	18.50	100.0	F BETWEEN FLT GND CREW	18.50	100.0
667 CORRODED-SEVERE	16.00	3.9	P REMOVED	16.00	100.0	F BETWEEN FLT GND CREW	16.00	100.0
799 NO DEFECT	15.30	3.7	Q INSTALLED	15.00	98.0	F BETWEEN FLT GND CREW	14.30	93.5
			X TEST-INSPECT-SERVICE	0.30	2.0	M PERIODIC/PHASED INSP	1.00	6.5
381 LEAKING INT OR EXT	13.30	3.2	G RPR/RPLT MINOR PARTS	13.30	100.0	F BETWEEN FLT GND CREW	10.00	75.2
						D INFLIGHT NO ABORT	2.00	15.0
						J PREFLIGHT	1.30	9.8
520 PITTED	11.80	2.9	G RPR/RPLT MINOR PARTS	7.80	66.1	M PERIODIC/PHASED INSP	7.80	66.1
			R REMOVE AND REPLACE	4.00	33.9	F BETWEEN FLT GND CREW	4.00	33.9
255 NO/INCORRECT OUTPUT	8.00	1.9	R REMOVE AND REPLACE	8.00	100.0	D INFLIGHT NO ABORT	8.00	100.0
800 NO DEF-RMVD-OTH MAINT	8.00	1.9	Q INSTALLED	6.00	75.0	M PERIODIC/PHASED INSP	6.00	75.0
			G RPR/RPLT MINOR PARTS	2.00	25.0	F BETWEEN FLT GND CREW	2.00	25.0
127 ADJMT/ALGNMT IMPROPR	7.50	1.8	G RPR/RPLT MINOR PARTS	7.50	100.0	F BETWEEN FLT GND CREW	7.50	100.0
108 MISSING BOLTS,NUTS..	7.00	1.7	G RPR/RPLT MINOR PARTS	7.00	100.0	M PERIODIC/PHASED INSP	5.00	71.4
						F BETWEEN FLT GND CREW	2.00	28.6
801 DETONATION	6.00	1.5	R REMOVE AND REPLACE	6.00	100.0	H POST/THRUFLT	6.00	100.0
750 MISSING	5.50	1.3	G RPR/RPLT MINOR PARTS	5.50	100.0	F BETWEEN FLT GND CREW	5.50	100.0
246 IMPROP/FAULTY MAINT	5.00	1.2	P REMOVED	5.00	100.0	F BETWEEN FLT GND CREW	5.00	100.0

Figure A-4. CH-53 Design/Cost MAMS (Continued)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

H-53 TRANSPARENCY WUCS ONAC AND SHOP 1/76-10/76 - MARSHALL STA 11-C3 MAR. 16, 1978 PAGE 8

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	8,193	16,436	$52,947	1,943.59	237.22

1111C WINDSHIELD ASSY RH (CONT.)	$7,104 LSC/YEAR	PCT OF LSC 13.42	LSC RNK TOTAL 3	432.30 MAN HRS	PCT OF MHR 21.21	MHR RNK TOTAL 2	50.3234 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF HMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF HMC
374 INTERNAL FAILURE	4.00	1.0	R REMOVE AND REPLACE	4.00	100.0	D INFLIGHT NO ABORT	4.00	100.0
070 BROKEN	3.00	0.7	R REMOVE AND REPLACE	3.00	100.0	D INFLIGHT NO ABORT	2.00	66.7
						F BETWEEN FLT GND CREW	1.00	33.3
242 FAILED TO OPERATE	3.00	0.7	R REMOVE AND REPLACE	3.00	100.0	F BETWEEN FLT GND CREW	3.00	100.0
660 STRIPPED	1.50	0.4	G RPR/RPLT MINOR PARTS	1.50	100.0	H POST/THRUFLT	1.50	100.0
230 DIRTY CONTAM SATURAT	1.30	0.3	G RPR/RPLT MINOR PARTS	1.00	76.9	M PERIODIC/PHASED INSP	1.30	100.0
			V CLEAN	0.30	23.1			
170 CORRODED-MILD/MODRTE	0.50	0.1	Z CORROSION REPAIR	0.50	100.0	M PERIODIC/PHASED INSP	0.50	100.0
117 DETERIORATED	0.40	0.1	G RPR/RPLT MINOR PARTS	0.40	100.0	M PERIODIC/PHASED INSP	0.40	100.0

Figure A-4. CH-53 Design/Cost MAMS (Continued)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

H-53 TRANSPARENCY WUCS ONAC AND SHOP 1/76-10/76 - MARSHALL STA 11-C3 MAR. 16, 1978 PAGE 9

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	8,193	16,436	$52,947	1,943.59	237.22

1111D WINDSHIELD ASSY CTR $3,579 LSC/YEAR | PCT OF LSC 6.76 | LSC RNK TOTAL 6 | 152.00 MAN HRS | PCT OF MHR 7.82 | MHR RNK TOTAL 4 | 18.5524 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF HMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF HMC
605 CRAZED	24.90	16.4	R REMOVE AND REPLACE	24.90	100.0	M PERIODIC/PHASED INSP	18.40	73.9
						F BETWEEN FLT GND CREW	6.50	26.1
105 LOOSE/DMGD BOLTS,NUT	18.40	12.1	G RPR/RPLT MINOR PARTS	18.40	100.0	M PERIODIC/PHASED INSP	11.70	63.6
						F BETWEEN FLT GND CREW	6.20	33.7
						R QC CHECK	0.50	2.7
070 BROKEN	16.00	10.5	G RPR/RPLT MINOR PARTS	16.00	100.0	M PERIODIC/PHASED INSP	16.00	100.0
935 SCORED OR SCRATCHED	16.00	10.5	R REMOVE AND REPLACE	16.00	100.0	M PERIODIC/PHASED INSP	16.00	100.0
799 NO DEFECT	12.00	7.9	Q INSTALLED	12.00	100.0	F BETWEEN FLT GND CREW	12.00	100.0
846 DELAMINATED	10.50	6.9	P REMOVED	7.50	71.4	F BETWEEN FLT GND CREW	7.50	71.4
			R REMOVE AND REPLACE	3.00	28.6	M PERIODIC/PHASED INSP	3.00	28.6
660 STRIPPED	8.50	5.6	G RPR/RPLT MINOR PARTS	5.00	58.8	F BETWEEN FLT GND CREW	8.50	100.0
			R REMOVE AND REPLACE	3.50	41.2			
117 DETERIORATED	8.00	5.3	R REMOVE AND REPLACE	8.00	100.0	F BETWEEN FLT GND CREW	8.00	100.0
190 CRACKED	8.00	5.3	R REMOVE AND REPLACE	8.00	100.0	F BETWEEN FLT GND CREW	8.00	100.0
780 BENT,BUCKLED,COLLASP	6.80	4.5	R REMOVE AND REPLACE	4.80	70.6	M PERIODIC/PHASED INSP	6.80	100.0
			P REMOVED	2.00	29.4			
900 BURNED OR OVERHEATED	6.00	3.9	R REMOVE AND REPLACE	6.00	100.0	O INFLIGHT NO ABORT	6.00	100.0
884 LEAD BROKEN	4.60	3.0	R REMOVE AND REPLACE	4.60	100.0	F BETWEEN FLT GND CREW	4.60	100.0
374 INTERNAL FAILURE	4.50	3.0	Y TROUBLESHOOT	4.50	100.0	F BETWEEN FLT GND CREW	4.50	100.0
651 AIR IN SYSTEM	4.50	3.0	Y TROUBLESHOOT	4.50	100.0	F BETWEEN FLT GND CREW	4.50	100.0
602 FAILED DUE TO OTHMAL	3.00	2.0	R REMOVE AND REPLACE	3.00	100.0	F BETWEEN FLT GND CREW	3.00	100.0
230 DIRTY CONTAM SATURAT	0.30	0.2	V CLEAN	0.30	100.0	M PERIODIC/PHASED INSP	0.30	100.0

Figure A-4. CH-53 Design/Cost MAMS (Concluded)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

H-03 TRANSPARENCY WUCS ONAC AND SHOP 1/76-10/76 - MARSHALL STA 11-C3 MAR. 18, 1978 PAGE 1

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	15,691	35,725	$219,665	1,645.69	104.88

1111E WINSHIELD $190,527 LSC/YEAR | PCT OF LSC 86.74 TOTAL | LSC RNK 1 | 949.70 MAN HRS | PCT OF MHR 57.71 TOTAL | MHR RNK 1 | 60.5251 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF HMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF HMC
935 SCORED OR SCRATCHED	283.50	30.9	R REMOVE AND REPLACE	164.20	52.5	F BETWEEN FLT GND CREW	135.30	46.1
			G RPR/RPLT MINOR PARTS	126.30	43.0	M PERIODIC/PHASED INSP	65.50	22.3
			F REPAIR	9.00	3.1	J PREFLIGHT	35.00	11.9
			Q INSTALLED	3.00	1.0	H POST/THRUFLT	33.70	11.5
			V CLEAN	1.00	0.3	D INFLIGHT NO ABORT	24.00	8.2
846 DELAMINATED	95.00	10.0	R REMOVE AND REPLACE	86.00	90.5	F BETWEEN FLT GND CREW	41.00	43.2
			G RPR/RPLT MINOR PARTS	9.00	9.5	M PERIODIC/PHASED INSP	23.00	24.2
						J PREFLIGHT	17.00	17.9
						D INFLIGHT NO ABORT	14.00	14.7
605 CRAZED	83.50	9.8	R REMOVE AND REPLACE	61.20	73.3	F BETWEEN FLT GND CREW	32.90	39.4
			P REMOVED	21.50	25.7	D INFLIGHT NO ABORT	24.60	29.7
			G RPR/RPLT MINOR PARTS	0.80	1.0	H POST/THRUFLT	15.00	18.0
						M PERIODIC/PHASED INSP	10.80	12.9
900 BURNED OR OVERHEATED	55.30	5.8	R REMOVE AND REPLACE	32.80	59.3	J PREFLIGHT	16.00	28.9
			P REMOVED	22.50	40.7	M PERIODIC/PHASED INSP	16.00	28.9
						D INFLIGHT NO ABORT	14.50	26.2
						H POST/THRUFLT	8.80	15.9
799 NO DEFECT	53.00	5.6	Q INSTALLED	53.00	100.0	M PERIODIC/PHASED INSP	38.00	71.7
						D INFLIGHT NO ABORT	8.00	15.1
						H POST/THRUFLT	6.00	11.3
						J PREFLIGHT	1.00	1.9
780 BENT,BUCKLED,COLLASP	42.50	4.5	R REMOVE AND REPLACE	28.50	67.1	D INFLIGHT NO ABORT	18.30	43.1
			P REMOVED	14.00	32.9	F BETWEEN FLT GND CREW	16.00	37.6
						H POST/THRUFLT	4.20	9.9
						M PERIODIC/PHASED INSP	4.00	9.4
381 LEAKING INT OR EXT	42.20	4.4	G RPR/RPLT MINOR PARTS	35.20	83.4	D INFLIGHT NO ABORT	25.70	60.9
			R REMOVE AND REPLACE	7.00	16.6	J PREFLIGHT	8.00	19.0
						M PERIODIC/PHASED INSP	7.00	16.6
						F BETWEEN FLT GND CREW	1.50	3.6
190 CRACKED	36.90	3.9	G RPR/RPLT MINOR PARTS	28.90	78.3	F BETWEEN FLT GND CREW	16.80	45.5
			R REMOVE AND REPLACE	8.00	21.7	M PERIODIC/PHASED INSP	14.80	40.1
						J PREFLIGHT	3.30	8.9
						R QC CHECK	2.00	5.4
105 LOOSE/DMGD BOLTS,NUT	36.30	3.8	G RPR/RPLT MINOR PARTS	34.80	95.9	M PERIODIC/PHASED INSP	23.50	64.7
			X TEST-INSPECT-SERVICE	1.00	2.8	F BETWEEN FLT GND CREW	12.80	35.3
			R REMOVE AND REPLACE	0.50	1.4			
520 PITTED	29.80	3.1	R REMOVE AND REPLACE	23.80	79.9	M PERIODIC/PHASED INSP	17.80	59.7
			G RPR/RPLT MINOR PARTS	6.00	20.1	F BETWEEN FLT GND CREW	12.00	40.3

Figure A-5. CH-3 Design/Cost MAMS

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	15,691	35,725	$219,665	1,645.69	104.88

1111E WINSHIELD (CONT.)	$190,527 LSC/YEAR	PCT OF LSC 86.74	TOTAL	LSC RNK 1	949.70 MAN HRS	PCT OF MHR 57.71	TOTAL	MHR RNK 1	60.5251 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF MMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF MMC
127 ADJMT/ALGNMT IMPROPR	28.90	3.0	G RPR/RPLT MINOR PARTS	19.90	68.9	F BETWEEN FLT GND CREW	24.90	86.2
			F REPAIR	5.00	17.3	M PERIODIC/PHASED INSP	2.50	8.7
			L ADJUST	2.80	9.7	H POST/THRUFLT	1.50	5.2
			A BNCH CK AND REPAIRED	1.20	4.2			
334 TEMPERATURE INCORR	24.00	2.6	R REMOVE AND REPLACE	24.00	100.0	J PREFLIGHT	24.00	100.0
600 NO DEF-RMVD-OTH MAINT	19.40	2.0	Q INSTALLED	11.70	60.3	M PERIODIC/PHASED INSP	10.00	51.5
			P REMOVED	7.70	39.7	F BETWEEN FLT GND CREW	9.40	48.5
106 MISSING BOLTS,NUTS..	18.70	2.0	G RPR/RPLT MINOR PARTS	18.70	100.0	F BETWEEN FLT GND CREW	9.70	51.9
						M PERIODIC/PHASED INSP	7.50	40.1
						D INFLIGHT NO ABORT	1.00	5.3
						R QC CHECK	0.50	2.7
567 RESISTANCE INCORRECT	13.50	1.4	Y TROUBLESHOOT	13.50	100.0	M PERIODIC/PHASED INSP	13.50	100.0
865 PROT COAT/SEALNT DEF	12.00	1.3	R REMOVE AND REPLACE	12.00	100.0	Q SPECIAL INSPECTION	12.00	100.0
020 WORN CHAFED OR FRAYD	11.50	1.2	G RPR/RPLT MINOR PARTS	7.00	60.9	F BETWEEN FLT GND CREW	11.50	100.0
			R REMOVE AND REPLACE	4.00	34.8			
			9 BNCH CK-CONDENNED	0.50	4.3			
750 MISSING	11.10	1.2	Q INSTALLED	6.50	58.6	M PERIODIC/PHASED INSP	4.60	41.4
			G RPR/RPLT MINOR PARTS	4.60	41.4	F BETWEEN FLT GND CREW	4.50	40.5
						H POST/THRUFLT	2.00	18.0
230 DIRTY CONTAM SATURAT	10.70	1.1	V CLEAN	10.70	100.0	M PERIODIC/PHASED INSP	6.00	56.1
						F BETWEEN FLT GND CREW	2.50	23.4
						J PREFLIGHT	1.00	9.3
						P FUNCTIONAL CK FLT	0.70	6.5
						D INFLIGHT NO ABORT	0.50	4.7
117 DETERIORATED	9.30	1.0	G RPR/RPLT MINOR PARTS	9.30	100.0	F BETWEEN FLT GND CREW	9.30	100.0
660 STRIPPED	6.00	0.6	G RPR/RPLT MINOR PARTS	3.00	50.0	F BETWEEN FLT GND CREW	4.50	75.0
			R REMOVE AND REPLACE	3.00	50.0	M PERIODIC/PHASED INSP	1.50	25.0
878 WEATHER DAMAGE	5.80	0.6	P REMOVED	5.80	100.0	M PERIODIC/PHASED INSP	5.80	100.0
070 BROKEN	5.50	0.6	R REMOVE AND REPLACE	4.00	72.7	M PERIODIC/PHASED INSP	3.00	54.5
			G RPR/RPLT MINOR PARTS	1.50	27.3	F BETWEEN FLT GND CREW	2.50	45.5
805 NO DEF-NOL-OTH MAINT	2.00	0.2	G RPR/RPLT MINOR PARTS	2.00	100.0	F BETWEEN FLT GND CREW	2.00	100.0
170 CORRODED-MILD/MODRTE	1.50	0.2	G RPR/RPLT MINOR PARTS	1.50	100.0	R QC CHECK	1.00	66.7
						M PERIODIC/PHASED INSP	0.50	33.3

Figure A-5. CH-3 Design/Cost MAMS (Continued)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

H-03 TRANSPARENCY WUCS ONAC AND SHOP 1/76-10/76 - MARSHALL STA 11-C3 MAR. 13, 1978 PAGE 3

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	15,691	35,725	$219,665	1,645.69	104.88

1111E WINSHIELD (CONT.)	$190,527	LSC/ YEAR	PCT OF LSC 86.74	TOTAL	LSC RNK 1	949.70 MAN HRS	PCT OF MHR 57.71	TOTAL	MHR RNK 1	60.5251 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF HMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF HMC
374 INTERNAL FAILURE	1.30	0.1	P REMOVED	1.30	100.0	F BETWEEN FLT GND CREW	1.30	100.0
667 CORRODED-SEVERE	0.50	0.1	V CLEAN	0.50	100.0	M PERIODIC/PHASED INSP	0.50	100.0

Figure A-5. CH-3 Design/Cost MAMS (Concluded)

DESIGN/COST MAINTENANCE ANALYSIS MODEL

H-1F/P TRANSPARENCY MJCS OMAC AND SHOP 1/76-6/77 - MARSHALL STA 11-C3 MAR. 16, 1978 PAGE 13

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	26,938	59,356	$73,431	7,780.85	288.84

11148 EXT STRUCT WINSHIELD $6,630 LSC/YEAR | PCT OF LSC 8.21 TOTAL | LSC RNK 7 | 729.66 MAN HRS | PCT OF MHR 9.38 TOTAL | MHR RNK 5 | 27.0866 MANHR /1000 FLT HR

MOH MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF MMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF MMC
605 CRAZED	192.12	26.3	R REMOVE AND REPLACE	127.12	66.2	H POST/THRUFLT	47.75	24.9
			P REMOVED	28.50	14.8	F BETWEEN FLT GND CREW	46.26	24.1
			G RPR/RPLT MINOR PARTS	26.50	13.8	M PERIODIC/PHASED INSP	41.60	21.7
			Q INSTALLED	10.00	5.2	J PREFLIGHT	40.50	21.1
						D INFLIGHT NO ABORT	16.00	8.3
935 SCORED OR SCRATCHED	120.21	16.5	R REMOVE AND REPLACE	70.01	58.2	F BETWEEN FLT GND CREW	84.01	69.9
			G RPR/RPLT MINOR PARTS	30.20	25.1	M PERIODIC/PHASED INSP	20.20	16.8
			V CLEAN	16.00	13.3	J PREFLIGHT	16.00	13.3
			P REMOVED	4.00	3.3			
105 LOOSE/DMGD BOLTS,NUT	102.31	14.0	G RPR/RPLT MINOR PARTS	102.31	100.0	M PERIODIC/PHASED INSP	44.86	43.8
						H POST/THRUFLT	21.10	20.6
						R QC CHECK	18.90	18.5
						F BETWEEN FLT GND CREW	12.45	12.2
						J PREFLIGHT	5.00	4.9
799 NO DEFECT	74.51	10.2	Q INSTALLED	63.84	85.7	F BETWEEN FLT GND CREW	64.17	86.1
			R REMOVE AND REPLACE	9.34	12.5	J PREFLIGHT	9.34	12.5
			X TEST-INSPECT-SERVICE	1.33	1.8	M PERIODIC/PHASED INSP	1.00	1.3
020 WORN CHAFED OR FRAYD	44.11	6.0	G RPR/RPLT MINOR PARTS	33.17	75.2	M PERIODIC/PHASED INSP	38.34	86.9
			R REMOVE AND REPLACE	8.83	20.0	F BETWEEN FLT GND CREW	4.77	10.8
			L ADJUST	2.10	4.8	R QC CHECK	1.00	2.3
190 CRACKED	43.14	5.9	G RPR/RPLT MINOR PARTS	42.14	97.7	F BETWEEN FLT GND CREW	40.01	92.7
			R REMOVE AND REPLACE	1.00	2.3	M PERIODIC/PHASED INSP	3.13	7.3
800 NO DEF-RMVD-OTH MAINT	41.17	5.6	S REMOVE AND REINSTALL	16.00	38.9	F BETWEEN FLT GND CREW	20.67	50.2
			Q INSTALLED	14.67	35.6	M PERIODIC/PHASED INSP	16.00	38.9
			P REMOVED	10.50	25.5	J PREFLIGHT	4.50	10.9
127 ADJMT/ALGNMT IMPROPR	31.26	4.3	G RPR/RPLT MINOR PARTS	23.25	74.4	M PERIODIC/PHASED INSP	21.00	67.2
			L ADJUST	8.00	25.6	F BETWEEN FLT GND CREW	9.25	29.6
						J PREFLIGHT	1.00	3.2
070 BROKEN	24.00	3.3	G RPR/RPLT MINOR PARTS	16.00	66.7	F BETWEEN FLT GND CREW	24.00	100.0
			P REMOVED	8.00	33.3			
230 DIRTY CONTAM SATURAT	19.85	2.7	V CLEAN	18.35	92.4	F BETWEEN FLT GND CREW	11.00	55.4
			X TEST-INSPECT-SERVICE	1.50	7.6	M PERIODIC/PHASED INSP	3.75	18.9
						D INFLIGHT NO ABORT	3.30	16.6
						J PREFLIGHT	1.80	9.1
240 IMPROP/FAULTY MAINT	13.05	1.8	G RPR/RPLT MINOR PARTS	12.80	98.1	R QC CHECK	8.00	61.3
			R REMOVE AND REPLACE	0.25	1.9	M PERIODIC/PHASED INSP	4.35	33.3
						H POST/THRUFLT	0.70	5.4

Figure A-6. UH-1F/P Design/Cost MAMS

DESIGN/COST MAINTENANCE ANALYSIS MODEL

H-1F/P TRANSPARENCY WUCS ONAC AND SHOP 1/78-6/77 - MARSHALL STA 11-C3 MAR. 16, 1978 PAGE 14

	FLIGHT HOURS	NO. OF FLIGHTS	LSC/YEAR	MANHOURS	MANHOURS/1000 FLIGHT HOURS
TOTAL	26,938	59,356	$73,431	7,780.85	288.84

11146 EXT STRUCT WINSHIELD (CONT.) $6,039 LSC/YEAR | PCT OF LSC 8.21 TOTAL | LSC RNK 7 | 729.66 MAN HRS | PCT OF MHR 9.38 TOTAL | MHR RNK 5 | 27.0866 MANHR /1000 FLT HR

HOW MALFUNCTION CODE NAME	MAN HOURS	PERCENT OF WUC	ACTION TAKEN CODE NAME	MAN HOURS	PERCENT OF HMC	WHEN DISCOVERED CODE NAME	MAN HOURS	PERCENT OF HMC
100 MISSING BOLTS,NUTS..	7.47	1.0	G RPR/RPLT MINOR PARTS	4.77	63.9	H POST/THRUFLT	4.67	62.5
			R REMOVE AND REPLACE	2.50	33.5	F BETWEEN FLT GND CREW	2.30	30.8
			Q INSTALLED	0.20	2.7	M PERIODIC/PHASED INSP	0.30	4.0
						R QC CHECK..	0.20	2.7
381 LEAKING INT OR EXT	3.00	0.4	G RPR/RPLT MINOR PARTS	3.00	100.0	D INFLIGHT NO ABORT	3.00	100.0
750 MISSING	3.00	0.4	Q INSTALLED	2.20	73.3	H POST/THRUFLT	2.20	73.3
			G RPR/RPLT MINOR PARTS	0.80	26.7	F BETWEEN FLT GND CREW	0.80	26.7
865 PROT COAT/SEALNT DEF	2.50	0.3	Z CORROSION REPAIR	2.50	100.0	H POST/THRUFLT	2.50	100.0
730 LOOSE	2.40	0.3	L ADJUST	2.40	100.0	M PERIODIC/PHASED INSP	2.00	83.3
						H POST/THRUFLT	0.40	16.7
170 CORRODED-MILD/MODRTE	2.30	0.3	Z CORROSION REPAIR	2.30	100.0	F BETWEEN FLT GND CREW	2.30	100.0
108 BRK/MSG SAFETY WIRE	1.50	0.2	G RPR/RPLT MINOR PARTS	1.50	100.0	M PERIODIC/PHASED INSP	1.50	100.0
117 DETERIORATED	1.00	0.1	R REMOVE AND REPLACE	1.00	100.0	F BETWEEN FLT GND CREW	1.00	100.0
660 STRIPPED	0.75	0.1	G RPR/RPLT MINOR PARTS	0.75	100.0	M PERIODIC/PHASED INSP	0.75	100.0

Figure A-6. UH-1F/P Design/Cost MAMS (Concluded)

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